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THE AETIOLOGY OF CHRONIC PRIMARY GLAUCOMA

BY

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IN a previous paper[1] I described primary glaucoma in association with epidemic dropsy. This interesting disease broke out again in parts of Bengal, Bihar, the United Provinces, Assam and Burma in 1934-35 and during this period 1,695 cases of this type of glaucoma came for treatment to the Eye Infirmary, Medical College Hospitals, Calcutta.

To-day most ophthalmologists regard the causation of primary glaucoma as evidence of a diseased state, not only of the eye but of the body in general.

With a view to the eludication of the aetiology of primary glaucoma in general this disease provided a vast field for research. It is the only general disease at present known in which glaucoma forms an integral part and hence is the biggest clinical lead we have ever had in the pathogenesis of glaucoma, and places primary glaucoma in its proper environment, namely a symptom complex of a general disease.

It is now definitely recognised that epidemic dropsy is an entirely different disease from beri-beri and there are no points of similarity either in the symptomatology or the pathology between the disease that is now epidemic in Bengal and the beri-beri which has been claimed as the human counterpart of polyneuritis gallinarum of fowls. Although the aetiology of epidemic dropsy in

the present state of our knowledge is unknown, there is more justification in placing this disease amongst the bowel diseases rather than the food deficiency diseases, and it would perhaps be more satisfactory if the Bengal epidemic dropsy were classified amongst the diseases of uncertain aetiology, as having nothing whatsoever to do with the diseases caused by vitamin "B" deficiency. In the pathology of epidemic dropsy whether regarded from the general or the ophthalmological or the dermatological aspects, there is never to be found any evidence of inflammation and the two outstanding manifestations are the vaso-dilatation of the whole capillary system and an increased permeability of the capillary endothelium.

In the eye, microscopic examination of the filtration angle shows that the canal of Schlemm and the tissues in the immediate vicinity do not show any abnormalities either in cellularity or increased fibrosis. The epithelium of the ciliary processes also does not show any change. Increased dilatation of the blood tissues is seen in the sub-epithelial connective tissue of these processes. There is also an enormous dilatation of the capillaries of the choroid, but there is no evidence of any inflammatory process to be found in the whole of the uveal tract. (See Figs. 1 to 4 and Plate I).

FIG. 1.

Photomicrograph of the filtration angle of the eye from a case of epidemic dropsy.
The channels of absorption (canal of Schlemm and tissues around) do not show any abnormalities either in cellularity or increased fibrosis.

FIG. 2.

FIG. 3.

Figs. 2 and 3 show different parts of the ciliary body. The epithelium of the ciliary processes does not show any change. Marked vascular dilatation is present in the sub-epithelial connective tissues. There is no evidence of any inflammatory process.

FIG. 4.

Photomicrograph of the choroid from a case of epidemic dropsy showing enormous dilatation of the capillaries. Such a vascular change in the choroid coat often gives an impression of haemorrhage although actual extravasation of blood in the tissues does not take place. The wide gap between the vascular and pigmented layer has been apparently caused during the preparation of the specimen.

In the present state of our knowledge the prevalent opinion is that the disease is associated with the ingestion of diseased, stored, par-boiled rice as patients recover quickly after a stoppage of rice in early cases: more advanced and late cases take a much longer period to recover according to the duration of the disease. Relapses invariably occur if the rice is resumed too early. These are liable to occur even when healthy rice is eaten suggesting that infection of the rice occurs in the intestines of the patient. Gram-positive organisms with certain special characteristics are frequently found in the stools of cases of epidemic dropsy and similar organisms have been recovered from diseased rice. In the Tropical School of Medicine, Calcutta, the blood and urine of a large number of epidemic dropsy cases have been examined during the different stages of the disease but no organisms have been found. From the stools of patients and from the infected rice some two hundred strains of Gram-positive spore-forming bacilli have been isolated and tested for agglutination with the sera of convalescent patients. Eight strains, four from actual patients, and four from

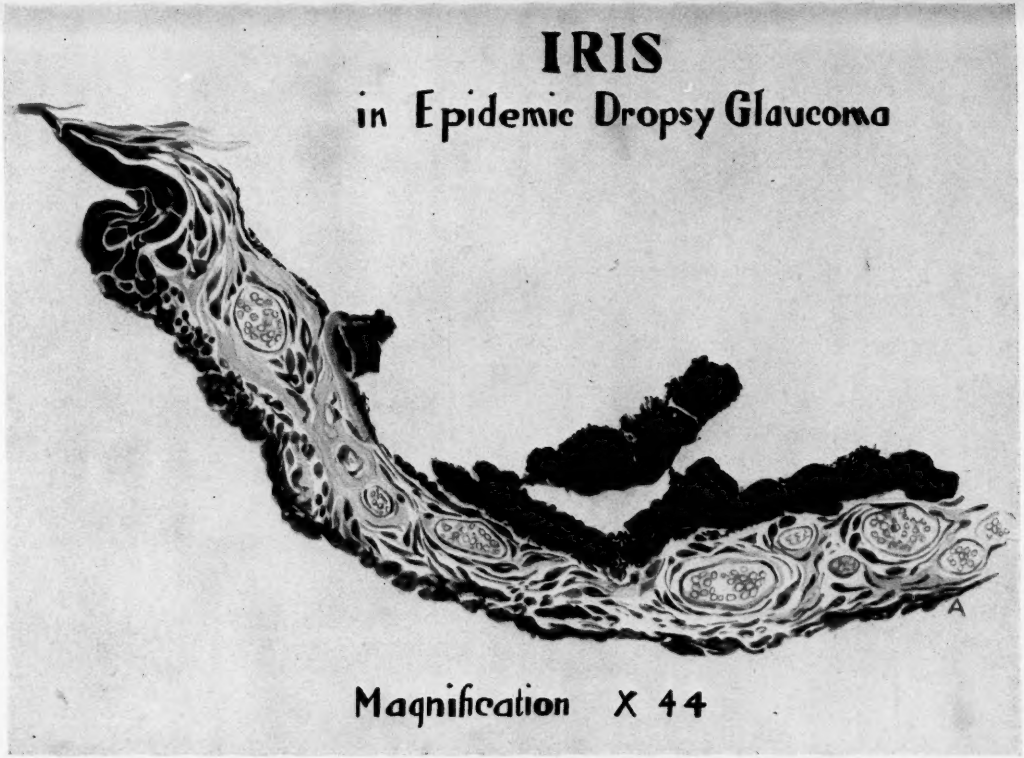

PLATE I.

Section of iris in epidemic dropsy glaucoma showing marked dilatation and engorgement of capillaries. Total absence of any sign of inflammation.

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rice were found to agglutinate in a high dilution with the sera of convalescent patients and not with the sera of normal persons. These observations are of importance in establishing the causation of the disease. The results so far obtained indicate that an organism of the genus Bacillus infects the rice and the ingestion of this rice leads to the development of the disease. Further, that the toxic or other products are elaborated mainly in the rice or in the presence of rice in the intestinal canal, and these toxins resemble a substance allied to an "H" substance or histamine in their action.

As pointed out before, glaucoma associated with epidemic dropsy is characterised by very high tensions occurring in both eyes at the same time, no lowering of the tension by miotics, the presence of a normal or deep anterior chamber, the absence of any inflammation or external signs of congestion, the occurrence of glaucoma in persons irrespective of age, and glaucoma may be the first manifestation of the toxaemia.

Recently I have been able to examine the aqueous humour in a limited number of cases of glaucoma associated with epidemic dropsy. Unfortunately from a theurapeutic point of view an anterior sclerotomy is of very little practical use as a means of treatment, as in all the cases in which "tapping" of the anterior chamber was carried out, sclero-corneal trephining had to be subsequently performed. Consequently one was not justified in "tapping" the anterior chamber in more cases. In some eyes this was performed under local anaesthesia with cocaine and in others it was done under general anaesthesia with sodium evipan. Altogether 23 cases were examined. Out of these, seven cases showed a well-marked histamine reaction. (See Fig. 5 and Table I). Sixteen cases failed to show any reaction whatsoever. Controls of 6 normal cases were also examined but failed to show any histamine reaction in the aqueous humour.

The protein fractions of the aqueous humour in eight cases of epidemic dropsy glaucoma were also examined by the refractometric method. The results of which are shown in Table II. Controls for the examination of protein fractions in the aqueous humour of 6 normal cases were also carried out, the results of which are shown in Table III. Examination of the aqueous humour in epidemic dropsy glaucoma shows that the percentage of albumen is greatly increased while the globulin remains the same; the normal ratio of albumen to globulin is 0·44 to 1·0 whereas in the aqueous humour of epidemic dropsy glaucoma, the albumen is more than the globulin in the ratio of 2·3 of albumen to 1·0 of globulin. Examination of the crystalloids in the aqueous humour shows no deviation from the normal. Examination of the aqueous humour in epidemic dropsy glaucoma for agglutinins was carried

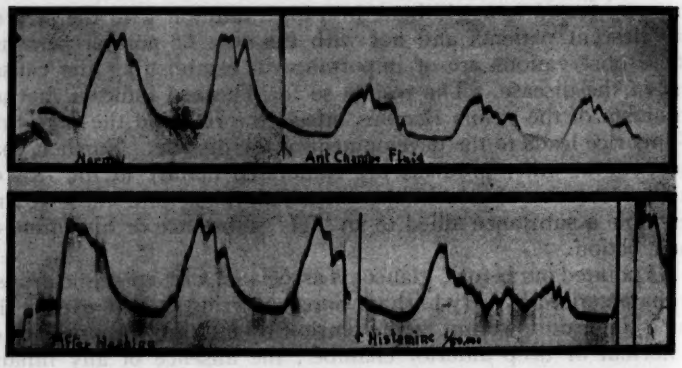

FIG. 5.

Kymograph record of the uterus of a white mouse showing a definite relaxation with the aqueous humour of Epidemic Dropsy Glaucoma and the relaxation with Histamine in 1/50,000 dilution.

out in 8 cases Specific agglutinins were found present in the blood serum but in no case were specific agglutinins found in the aqueous humour. This is of great interest as it is known that agglutinins are fastened to the globulins and not to the albumens in the blood serum. The results of these are shown in Table IV.

Examination of the blood sera of patients suffering from epidemic dropsy glaucoma shows that the total proteins have diminished and that this diminution is due to a considerable decrease in the albumen content. At the same time pseudo-globulin and eu-globulin have increased but not to such an extent as to compensate for the reduction of albumen. As the protein content of the serum is responsible for the physical state of the blood so these changes must necessarily have a great influence on the various physical and chemical properties of the serum.

Chopra and his co-workers[2] have proved in the sera of patients suffering from epidemic dropsy that the relative viscosity and surface tension are below normal values. The pH remains unaltered while the buffer action is also below normal. The higher viscosity value rests upon the constituent proteins. Of the three proteins that contribute to the viscosity of the serum, eu-globulin stands first in order, then comes pseudo-globulin and last of all comes the albumen fraction. Although there is a fair increase of pseudo-globulin and a small increase of eu-globulin in these cases they cannot in all probability counterbalance the effects produced by the decrease in the albumen fraction. The lowering of surface tension together with the diminution of the viscosity is unusual as a fall in viscosity is generally attended by a rise in surface tension.

TABLE I

PRESENCE OF "H" SUBSTANCE IN THE AQUEOUS HUMOUR OF EPIDEMIC DROPSY GLAUCOMA CASES

Serial No.	Name	Age	Sex and Caste	Eye operated	Tension	Vision	Date of operation	Operation	Anaesthesia	Quantity of "H" substance	Remarks
1	A.D.	18	H.F.	L.E.	67	3/60	23/5/34	A.C. tapped	Local—cocaine drops	Histamine + + +	1st attack—3 years ago; duration 6 months. 2nd attack—4 months' duration
2	G.B.S.	22	H.M.	R.E.	57	6/36	20/8/34	A.C. tapped	Local—cocaine drops	Histamine + +	E. D. duration 3 months
3	R.B.	16	H.M.	R.E.	36	6/9	7/9/34	A.C. tapped	Sodium evipan	Histamine + +	1st attack—5 years ago 2nd attack —1 month duration
4	A.K.	52	M.F.	L.E.	57	6/24	29/9/34	A.C. tapped	Sodium evipan	Histamine + +	1st attack—duration 2 months
5	R.D.	21	H.F.	R.E.	77	6/9	13/12/34	A.C. tapped	Sodium evipan	Histamine + +	E. D. duration 4 months
6	T.D.	45	H.M.	R.E.	41	F.M.	28/1/35	A.C. tapped	Sodium evipan	Histamine + +	1st attack—4 years ago. 2nd attack —1 year duration
7	J.B.	28	H.F.	L.E.	53	6/6	1/2/35	A.C. tapped	Sodium evipan	Histamine + +	E. D. duration 5 months

TABLE II

PROTEIN FRACTIONS IN AQUEOUS HUMOUR IN EPIDEMIC DROPSY CASES

	Albumen in gms. %	Globulin in gms. %	Total proteins in gms. %	Globulin to albumin ratio	Non-proteins in gms. %
Case I - - - -	—	—	0·0204	—	—
Case II - - - -	0·011	0·0044	0·0154	0·408	1·27
Case III - - - -	0·028	0·0130	0·0410	0·464	0·90
Case IV - - - -	0·021	0·0089	0·0299	0·420	1·13
Case V - - - -	0·028	0·0090	0·0370	0·400	1·15
Case VI - - - -	0·016	0·0090	0·0250	0·550	1·00
Case VII - - - -	0·022	0·0089	0·0309	0·410	1·04
Case VIII - - -	0·038	0·0190	0·0570	0·500	1·11
Average for aqueous humour of E.D. cases -	0·023	0·010	0·0310	0·450	—
Average for the blood sera of E.D. cases -	3·74	3·39	7·23	0·90	1·25
Average for the blood sera of normal man .	4·61	2·83	7·44	0·611	1·30

TABLE III

PROTEIN FRACTIONS IN AQUEOUS HUMOUR IN *NORMAL* CASES

Case No.	Disease	Albumen in gms. %	Globulin in gms. %	Total proteins in gms. %	Globulin to albumen ratio
I - -	Cataract	0·008	0·012	0·020	1·500
II - -	Cataract	0·005	0·015	0·020	3·000
III -	Cataract	0·003	0·011	0·014	3·666
IV - -	Cataract	0·0038	0·009	0·0128	2·368
V - -	After cataract	0·0041	0·0096	0·0137	2·341
VI - -	After cataract	0·0012	0·004	0·0052	3·333

TABLE IV

LIST OF CASES OF EPIDEMIC DROPSY GLAUCOMA IN WHICH AGGLUTININS WERE TESTED

Serial No.	Name	Age	Sex and Caste	Eye operated	Tension	Vision	A.C. tapped under sodium evipan	History of epidemic dropsy glaucoma	Agglutinins			Remarks
									Blood serum	Aqueous humour	Against	
1	H.C.G.	48	H.M.	L.E.	67 mm. Hg	F.m.	,,	6 months' duration		Absent	T.A.B. vaccine	Advanced case
2	S.D.B.	35	H.F.	R.E.	57 mm. Hg R.E.	R.E 6/12	,,	3 months' duration		Absent	,,	
3	P.B.	26	H.F.	L.E.	R.E. 67 mm. L.E. 77 mm.	R.E. 1/60 L.E. F.m.	,,	6 months' duration	+ in 1/250	Absent	Rice bacilli	Advanced case
4	P.L.P.	36	H.M.	R.E.	B.E. 67 mm.	R.E. 6/24 L.E. 6/6	,,	2½ months' duration	+ in 1/250	Absent	,,	
5	D.C.S.	25	H.M.	R.E.	R.E. 70 L.E. 60	R.E. 2/60 L.E. 6/6	,,	1 month's duration		Absent	,,	
6	K.G.	44	H.F.	R.E.	R.E. 57 mm. Hg L.E. 67 mm. Hg	R.E. P.L. L.E. 6/18	,,	3 months' duration	+ in 1/125 + 1/25	Absent	,,	Advanced case
7	S.J.	56	H.F.	R.E.	R.E. 50 L.E. 40	R.E. F.m. no imp. L.E. $\bar{c}$ + 11·0 D.S. =6/9	,,	3 months' duration	+ in 1/250 and 1/50	Absent	,,	2 years back B.E. operated for cataract
8	M.M.	20	H.F.	R.E.	R.E. 60 mm. L.E. 55 mm.	R.E. 6/12 L.E. 6/9	,,	3 months' duration	+ in 1/125 and 1/50	Absent	,,	

The primary factors in the production of an increased amount of aqueous humour in the eye-ball are:—

(1) Decrease in the colloid osmotic pressure of the serum.

(2) Increase in the permeability of the capillary wall so that the albumen molecules can pass through from the capillaries into the aqueous humour. The albumen molecules are much smaller than those of other proteins in the blood and can pass out more easily than others into the aqueous. The change in the surface tension is closely associated with the change in permeability. It is probable that the histamine-like body which has been proved to be present in some cases associated with epidemic dropsy produces similar reactions. The colloid osmotic pressure exerted by a certain percentage of albumen is much higher than that of an equal percentage of globulin and as albumen is composed of smaller molecules than globulin a given concentration of albumen therefore contains more molecules than the same percentage of globulin and has a higher actual osmotic pressure, due to the protein molecules. The increased permeability of the capillary walls causes a lower colloid osmotic pressure and the greater the permeability of the membrane, the lower the pressure.

(3) Increase in the hydrostatic pressure in the blood capillaries.

It is obvious that the operation of these three factors serves to aid the transudation from the capillaries into the aqueous humour in the eye-ball and to hinder reabsorption from the latter, thereby causing an increased amount of aqueous humour.

Summary

In the sera of patients suffering from epidemic dropsy the relative viscosity and the surface tension are lowered below normal. The pH remains unaltered while the buffer action is also below normal. The protein fractions show a considerable reduction in albumen while the globulins are found to be increased. The increase of pseudo-globulin is more marked than that of eu-globulin. In the aqueous humour of patients suffering from epidemic dropsy glaucoma there is a marked increase of the albumens while the globulins remain the same. The normal ratio of albumen to globulin is 0·44 to 1·0 whereas in the aqueous humour of epidemic dropsy glaucoma, the albumen is more than the globulin in the ratio of 2·3 of albumen to 1·0 of globulin. In a certain number of patients suffering from epidemic dropsy glaucoma, a histamine-like body has been proved to be present in the aqueous humour. The whole uveal tract shows a marked dilatation of the capillaries, and there is no evidence of any inflammatory process.

My thanks are due to Colonel R. N. Chopra and his co-workers in the Tropical School of Medicine, Calcutta, for their assistance in the examination of the aqueous humour. I am also indebted to my House Surgeon, Dr. P. K. Biswas, for his valuable help in this research.

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INTENSITY OF LIGHT IN RELATION TO THE EXAMINATION OF THE EYE*

BY

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I. In the Correction of Errors of Refraction.

1. Myopia, hyperopia and astigmatism by the acuity method.
2. Astigmatism by special tests.
   (*a*) With the broken circle and the illumination scale.
   (*b*) With the radial line type of test chart.
3. The presbyopic eye for near seeing.

II. In the Standard Rating of Acuity and Its Rating for Other Purposes.

III. In the Determination of the Near Point of Vision and the Apparent Range of Accommodation.

IV. In the Study of the Visual Field with the Tangent Screen and the Perimeter.

In July, 1934, we published the description of an instrument which provides a convenient means of varying the intensity of illumination over a wide range from zero to very high without change in the colour of light or in the size, shape and location of the illuminated field.[1] This instrument was devised as an aid to the practitioner in examining the eye as well as in caring for it by prescribing the amount of light needed by the patient under examination. The use of variable illumination in the correction

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of myopia, hyperopia and astigmatism; for the determination of the near point of vision; in the standard rating of acuity and its rating for other purposes; and in the study of the visual field with the tangent screen and perimeter have already been discussed in print and will be briefly reviewed in the following sections. Its use in the examination of the presbyopic eye and the selection of the proper strength of glasses for near work will be considered in this paper. Relating to the need for prescribing the amount of light for reading and other types of work, we have recently completed a survey on this point of more than 600 cases evenly distributed in the decade age groups from 10 to 70 years. The results of this survey will soon be published. It may be noted here, however, that in any series of tests for the prescribing of light it will be found that the major need for individual testing is for the adolescent, the sick and defective, and for the presbyopic and near-presbyopic eye. There is much less need for individual testing of normal eyes between the ages of 20 and 35 years. We have found that the greater number of these eyes prefer a medium intensity of light over a comparatively small range. In case of the presbyopic eye the greatest benefit from the test may be had for eyes in the early and middle stages of presbyopia.

In the Correction of Errors in Refraction

1. MYOPIA, HYPEROPIA AND ASTIGMATISM BY THE ACUITY METHOD, i.e., WITH THE CONVENTIONAL LETTER CHART.

There are three important factors in the visibility of the image on the retina: its clearness, which is dependent on the refractive mechanism; its subjective or sensation difference from the background, which is dependent both on the physical difference in reflection between object and background and on the intensity of the illumination; and its size. It is obvious that if we wish to test the clearness of the image with the purpose of obtaining the greatest possible clearness of outline, the test should not be made in the presence of a high value of either of these other two cardinal factors. Writers and workers in this field early recognized that size of object must be reduced to a minimum if high sensitivity is wanted for the acuity method of detecting errors in refraction. No one would have recommended, for example, that large test letters be used for a decision as to which correcting glass best remedies defects in imagery. It is somewhat strange, therefore, that the other extremely important factor, namely the sensation difference from the background, should have been overlooked.

With a given physical difference from the background, *i.e.*, a given difference in reflection factors, the apparent or sensation

difference increases rapidly with increase in the intensity of light. This, together with the better focusing action of the refractive mechanism due to the small pupil characteristic of high intensities, gives rise to higher values of visual acuity with higher intensities of illumination. High intensities give the retina much greater power to discriminate detail in the image formed than do low intensities, therefore greater power to compensate for the error in refraction which it is the purpose of the test to disclose. Even though the image is badly blurred, the detail can be discriminated when the intensity is high. From this it follows that high intensities of light operate against the sensitivity of the test for the detection of errors in clearness of imagery by the acuity method. The test may be begun at a medium intensity, but it should be finished at a low intensity. It is our experience that except in cases where acuity is greatly reduced by causes that cannot be remedied by refractive means, intensities of 0·5 ft.-c. or less give maximum sensitivity for the final correction of myopia, hyperopia and astigmatism by this method.[2]

2. ASTIGMATISM BY SPECIAL TESTS.

(*a*) *With the use of the broken circle and the illumination scale.*—Several years ago we devised a very sensitive test for astigmatism based on the use of the broken circle in connection with a variable intensity of illumination. The principle is that the opening in the circle should require the same minimum intensity of illumination for its discrimination in whatever direction it may be turned, provided the resolving or imaging power of the refracting system is equal in all meridians. If the resolving power is poorer in some one meridian than in the others, more light is required for its discrimination in that meridian. Differences in the intensity of illumination required to make the opening visible may then be used as a means of detecting differences in resolving power in the different meridians. Differences in size of opening could also be used for this purpose, but we would have to be able to produce and measure much smaller differences in size than in intensity of illumination in order to detect small differences in resolving power because of the much greater effect of size than intensity of illumination on the visibility of objects.

The illumination scale, being in comparison an amplified scale, is much more sensitive, therefore, for detecting small differences in the resolving power of the refractive system than the visual angle scale. Also changes in illumination can be more easily made in continuous series than changes in size and can be used with equal facility with any type or number of types of test object.

The method of using the test is as follows: The amount and axis of the defect is first roughly determined by the customary less sensitive means. With the correction indicated worn by the patient, the opening of the circle is turned in succession into the two critical meridians and the amount of light required for its discrimination determined. If this is not equal, slight changes are made in the axis of the cylinder, corresponding changes being made also in the position of the opening. If this does not render equal the amount of light required to discriminate the opening in the two positions, changes are made in the strength of the cylinder and the test procedure repeated.

More recently we have shortened the procedure to one-half by using two openings in the circle with their centres displaced from

FIG. 1.

The new type of broken-circle test object drawn to the 1—5 min. scale.

each other by 90 degrees. The use of this type of circle in no way decreases the sensitivity of the test and has, besides, the technical advantage that the test in both meridians can be made simultaneously. Simultaneous comparisons are in general always to be preferred to successive comparisons and particularly in case of astigmatism when the test is made in the absence of cycloplegia. Also, as stated above, the test with the two openings can be made in one-half the time. A representation of this circle drawn to the 1-5 minute scale is given in Fig. 1. The test could be made with a variable illuminator such as is mentioned above, and a printed rotatable double-broken circle as test object, or less successfully with the Ferree-Rand double-broken circle chart for testing acuity and astigmatism. From the standpoint of ease and convenience of examination it can best be made with an acuity projector of the type devised by us which is provided with a double-broken circle in the form of a rotatable lantern slide and a means of varying the intensity of light.

As illustrative of the sensitivity of the test, the following data may be cited: (*a*) *For different amounts of astigmatism.* Five observers on the average required 55 per cent. more light to detect the opening of the test object in the unfavourable than in the favourable meridian of a 0·12 dioptre astigmatism; 109 per cent. more light for a 0·25 dioptre astigmatism; and 178 per cent. more light for a 0·75 dioptre astigmatism. (*b*) *For different amounts of astigmatism with the correcting cylinder placed off axis.* Five observers on the average required 67 per cent. more light to detect the opening of the test object in the unfavourable than in the favourable meridian of a 0·25 dioptre astigmatism when the axis of the correcting cylinder was displaced 5 degrees and 96 per cent. more light when it was displaced 10 degrees; in case of a 0·75 dioptre astigmatism, they required 107 per cent. more light when the axis of the correcting cylinder was displaced 5 degrees and 160 per cent. more when it was displaced 10 degrees. In obtaining the above results artificial astigmatisms were created for (*a*). For (*b*) artificial astigmatisms were created and the proper strength of correcting cylinder was placed the designated amount off axis. The experiment was conducted in this way because we wished to know the exact amount and location of the refractive defect for making the determinations.[3]

(*b*) *With the radial line type of test chart.*—Great sensitivity may be added to the use of charts of the radial line type by conducting the test at a very high intensity of illumination. The illuminating light should be of high intensity in order to give as much light as possible to be refracted or blurred across the black lines in the image on the retina in the meridians affected by the astigmatism. Obviously, the higher is the reflecting power of the background and the greater the intensity of the incident light, the greater will be the amount of light that is blurred across the black lines in the image and the lighter will they become. The difference in the blackness of line in the meridians affected and those not affected by the astigmatism is, it will be remembered, the crucial feature of the test.

Further, it has also been found of value in many cases of slight astigmatism to vary the illumination on the chart rapidly from high to low and back again to high in order to take advantage of the rapidly changing contrast sensitivity of the eye during change of intensity of illumination, thus accentuating the difference between the blurred grey lines and the sharply-focused black lines of the chart.

Some experiments conducted by us to show the effect of intensity of illumination on the sensitivity of the test for detecting errors in the placement of the correction may be mentioned here. Artificial astigmatisms were created by the use of 0·12 and 0·25 dioptre

cylinders and the appropriate correcting cylinder was placed successively at 5, 10, 15, 20, 25, 30, 35 and 40 degrees off axis. With these settings of the correcting cylinder the amounts of light were determined that were necessary for the observer just to detect the error in the placement of the correction by the difference in blackness of the lines of the chart. The results are shown in Table 1.

TABLE I

Showing the intensity of illumination of the radial line chart required to detect given amounts of error in the placement of the correction of an artificial astigmatism.

Strength of artificial astigmatism (dioptres)	Amount correcting cylinder is placed off axis (degrees)	Intensity of illumination required to detect error in placement of correction (foot-candles)
0·12	5	61·0
	10	51·0
	15	45·0
	20	40·0
	25	37·0
	30	34·0
	35	30·5
	40	28·0
0·25	5	50·0
	10	35·0
	15	26·5
	20	18·1
	25	11·1
	30	7·8
	35	5·3
	40	4·7

Important factors in the sensitivity of the test are high intensity of illumination, high reflecting power of background, minimum reflecting power of the radial lines (narrow black velvet ribbon excellent for this purpose), and optimum breadth and spacing of the lines.[4]

3. THE PRESBYOPIC EYE FOR NEAR SEEING.

There are two ways of aiding the presbyopic eye to see its object at the desired near distance, namely, a correcting glass and intensity of light. The former of these is the major and the latter a minor or auxiliary aid. However, the proper selection of either cannot be had without reference to the other. The preferred procedure is the selection of the optimum combination of intensity of light and strength of glass.

So far as the correcting glass is concerned, it may be said that the strength of glass required at a given near distance sustains, within comparatively narrow but significant limits, an inverse relation to the intensity of light used. At high intensities the work can be discriminated with a weaker glass than at medium and low intensities. This is due, for the greater part, if not entirely, to the effect of the higher intensities of light on acuity and the visibility of the object.[5] There are the following objections to the use of high intensities in selecting the correcting glass: (1) If a glass were selected at a high intensity it would have to be used at high intensities. So selected, the glasses prescribed would be unsatisfactory for work at medium and low intensities. (2) High intensities are difficult to obtain in present lighting practice with adequate protection from glare from the source of light. Also prolonged use of too high an intensity of light is apt to cause discomfort because of glare from the page or other work due to a too high brightness. (3) The glasses would have to be used in all sorts of locations and situations. High intensities are not to be found in all locations and situations, and probably never will be.

With decrease of intensity less effect of the change on the preferred strength of glass is found—little, in fact, until very low illuminations are reached. At these illuminations the tendency is to choose a stronger glass in order to secure a benefit from magnification. This glass, however, would not, in most cases, be satisfactory at medium and high intensities without changing the distance of the work, and probably not even then because of the greater amount of convergence required, the less favourable relation between accommodation and convergence, and the undue limitation of the range of distance over which the object can be discriminated. At these intensities the additional magnification is not needed for the comfortable discrimination of the object.

Obviously, then, the practical procedure requires that in general the glass be prescribed of a strength that is most satisfactory for the range of intensities that prevails at any given time in the current practice of lighting—due exception being made for cases where the glasses are to be used only or primarily at other intensities of illumination. Assuming that this range is now from 5 to 20 ft.-c., that glass should be selected which is the most satisfactory throughout this range, the test being made a 5, 10, 15, 20 ft.-c. or at other suitable intervals.

Our experience leads us to believe that in the greater number of cases, a glass which is satisfactory for this range will also be reasonably satisfactory in case higher intensities of light are preferred because of some condition of the sensorium or for other reasons. If not, the problem becomes in such cases to find the

best combination of strength of glass and intensity of light. With a convenient means of varying the intensity of illumination, this should not be difficult to do. The ability to control at will the important factor of intensity of light gives a certainty and finish to the test which is highly gratifying to the careful worker and is not to be had from a variation in the strength of the glass alone. We very strongly believe that some satisfactory type of variable illuminator should supplement the trial case as part of the standard equipment of the refractionist.

Although we do not consider it worth while to give here the test data for any considerable number of cases, we do, however, feel justified in citing one case which seems to be typical, as illustrative of what has been said above. A. G., male, aged 56 years, by occupation an instrument maker, preferred for reading at 30 ft.-c. +1·37 S. right eye, and +1·25 S. left eye, in addition to his correction for distance; at 10 to 20 ft.-c., +1·50 S. right eye, and +1·37 S. left eye; at 5 ft.-c. +1·62 S. both eyes; at 3 ft.-c., +1·87 S. both eyes; and at 1·5 ft.-c., +2·12 S. both eyes. His preferred intensity of illumination for reading was 11 to 12 ft.-c.; his toleration for intensity for comfortable reading ranged from 5 to 16 ft.-c. His preferred combination of strength of glass and intensity for reading was, then, +1·50 S. right eye, +1·37 S. left eye, and 11 to 12 ft.-c. of illumination. This combination had all the desired requirements for reading, namely, the intensity of light preferred, a strength of glass that was entirely comfortable, and a range of distance over which the object could be seen with satisfactory clearness greater than for any other combination that was comfortable. The favourable range of distance here was due both to lesser strength of glass and to the very satisfactory visibility given by the comparatively high intensity of light. The combination of +1·37 S. right eye, and +1·25 S. left eye, and 30 ft.-c. of illumination was not preferred because this intensity was glaring and higher than his limit of toleration for comfortable reading. The glass chosen for this illumination was too weak for intensities of 20 ft.-c. and less. On the other hand, the glass chosen for 1·5 ft.-c. was too strong to be comfortable at 3 or more ft.-c. This glass was chosen only because a benefit of magnification was needed to overcome the low visibility due to the small amount of light. The glasses chosen for 3 and 5 ft.-c. were, however, comfortable at higher intensities up to his upper limit of toleration for intensity of light for reading, but were not preferred at these intensities because they were stronger than was needed and, therefore, limited unduly the range of distance over which the object could be comfortably discriminated. While he had facilities in his own shop for 10 ft.-c. and more, his work was on dark material, and often required him to go from room to room to examine and

repair apparatus where that much illumination was not provided. In such a case we would not feel justified in prescribing the glasses that were preferred at higher than 3, or at most, 5 ft.-c.

We would again urge that due attention be given to both factors, strength of glass and intensity of light, in making a prescription for either. This indicates clearly that the prescribing of glasses and the prescribing of light should be done by one who is competent to give both factors due consideration. Often too strong glasses are prescribed because too low an intensity of light has been used in making the examination; and conversely, frequently too high an intensity of light is advised or required because the person is wearing too weak a glass, in which case he may be compelled for the sake of adequate visibility to work above his threshold of glare.

This discussion, it will be understood, has no adverse bearing on any ideal or just desire to raise the general level of intensity in lighting practice. In fact, the procedure recommended is the authorized way to bring about an increase in the amount of light used by that part of our population most in need of it, namely, the middle-aged and old—an increase that will have permanence and stability because it is based on the sound foundation of a physiological requirement. Obviously, the safe and sure aid to advancement in the solution of the problem of intensity is through some authentic test procedure or other competent means of advisement supplemented by convenient and satisfactory ways and devices of adapting intensity to the variable needs. Any plan or course of action not based on a reasonably thorough understanding of the ocular situation is apt to prove detrimental and reactionary.

The raising of the level of intensity to any considerable extent will come only with great labour and great patience of endeavour. The prescribing of glasses cannot wait for the desired progress in that direction. We are dealing here with a practical situation in the present. When such progress comes, it can be taken into account in the test procedure; that is, the test will be made at higher intensities of light. At these intensities a weaker glass will be preferred for near work, which will have the very desirable feature of a greater range of distance over which the glasses will provide clear seeing. Also the glasses will not need to be changed so frequently as presbyopia advances. Both of these are very important, particularly the range of distance over which the object can be seen clearly. It may be added, however, that in connection with the raising of the level of intensity, full consideration must be given to the threshold of glare. This varies a great deal in different individuals, but in the same individual does not seem to be materially affected by strength of glass over the range that is apt to be prescribed. Also it is considerably lower for

artificial light than for either daylight or artificial light properly corrected for colour. Further, we are inclined to believe, both from items of our own experience and from the experience of others, that it is lower even for sunlight than for daylight.

In the Standard Rating of Acuity and its Rating for other Purposes

For a suitable intensity of illumination of the test charts used in making standard ratings of visual acuity, it might be suggested that an attempt be made to approximate the standard of lighting practice. However, standards of practice in commercial lighting change greatly from time to time and, moreover, it is difficult at any one time to determine just what the standard is. Again, the current aim in commercial lighting seems to be by the use of high intensities to give all eyes good vision; that is, to eliminate as far as possible individual differences. This is hardly suitable for a scale the purpose of which is to rate all eyes fairly as to their powers of vision. Further, the higher intensities do not sufficiently rule out those disqualified by age in cases where the standard rating of acuity is to be used as the basis of selection for special fitness. For this purpose it would seem better to select a medium intensity, for example, 10 ft.-c. For the sake of simplicity of specification and of equipment required, the intensity could, without sacrifice of fitness for the purpose, be made the same as is now commonly accepted for perimetry and the study of the visual field, namely, 7 ft.-c.

In the rating of eyes as to fitness for vocations, the test should be made as nearly as possible at the illumination usually employed in the vocation in question. The study of even a small number of cases shows that eyes are not given the same relative rating as to acuity at different intensities of illumination. For example, experience has shown in the U.S. Navy that only 25 to 30 per cent. of the men accepted for the service on the basis of the conventional acuity test made at the higher illuminations are able to qualify for the look-out work at night on the bridge of battleships. Further, in a test of 61 observers made by us, all under 28 years of age and rating 6/4 acuity by the conventional test with 5 ft.-c. of light on the test chart, 13 per cent. rated below 6/6 at 0·55 ft.-c., and 33 per cent. below 6/6 at 0·2 ft.-c. The acuity of the remainder was 6/6 or better at these illuminations. It is quite obvious that any attempt to rate eyes for vocational purposes at only one, or even one order of intensity of illumination is based on a lack of knowledge of the differential effect for different eyes of intensity of illumination on the power of the eye to see clearly.

Perhaps nowhere in the examination of the eye is there shown a greater need for a ready means of varying the intensity of the illumination and of measuring what is produced than in the rating of acuity in its various applications. At present there is great confusion as to the ratings made in relation to special fitness and the comparative ratings made of the same person at different times and in different places.[6]

In the Determination of the Near Point of Vision and the Apparent Range of Accommodation

There is a considerable effect of increase of intensity of light on the distance of the near point of vision and therefore on the apparent range of accommodation. The effect is present at all ages, but is much greater for middle-aged and old than for young eyes and for presbyopic than for non-presbyopic eyes.

For example, in a group of 12 observers without presbyopia, ranging in age from 20 to 41 years, we have found that by increasing the intensity of light from 1 to 5 ft.-c., the distance of the near point was decreased for the different individuals 1·8-26 mm., or 2-26 per cent.; for an increase of from 1 to 25 ft.-c., the distance of the near point was decreased 3-45 mm., or 3-28 per cent. In a group of 14 presbyopic observers, ranging in age from 40 to 53 years and in strength of correction for near vision from 1 to 2 dioptres, an increase of intensity from 1 to 5 ft.-c. decreased the distance of the near point 90-540 mm., or 18-51 per cent.; while an increase of intensity from 1 to 25 ft.-c. decreased the distance of the near point 170-690 mm., or 32-73 per cent.

The increase in apparent range of accommodation for these observers expressed in dioptres was as follows: For the group without presbyopia, an increase in intensity from 1 to 5 ft.-c. increased this range 0·18-1·19 dioptres, or 2-19 per cent. for the different observers; and an increase from 1 to 25 ft.-c. increased it 0·27-2·38 dioptres, or 3-39 per cent. For the group of presbyopic observers, an increase of intensity from 1 to 5 ft.-c. increased the apparent range of accommodation 0·33-1·3 dioptres, or 22-105 per cent.; and an increase of intensity from 1 to 25 ft.-c. increased this range 0·61-4·32 dioptres, or 48-477 per cent.

In addition to showing the very great benefit of intensity of light to the near vision of older and particularly of presbyopic eyes, these results demonstrate the need for the adoption of some fixed value of intensity for all standard determinations of the near point and range of accommodation. There is no reason why this intensity should not be the same as was recommended for the

standard rating of visual acuity. When used in conjunction with the prescribing of glasses, however, the values of the near point should also be established and recorded for the intensity of light for which the reading glasses are prescribed.[7]

In the Study of the Visual Field with the Tangent Screen and Perimeter

Studies of the visual field are very important in all pathological conditions of the sensorium. Within a 30-degree distance of the centre of the field these studies can be made with either the tangent screen or the perimeter. Outside this distance the perimeter should be used. The variable illuminator mentioned earlier in the paper is very useful for studies with the tangent screen. For the Ferree-Rand perimeter we have provided a special form of illuminating device having the same type of intensity control as is used in our variable illuminator, which is attached to the instrument.

The following uses and advantages of variable illumination in connection with studies of the visual field may be briefly mentioned:

(1) As the initial step in the routine procedure for determining the limits of the visual field and blind spot, the study should always be made at the intensity of illumination which is at present accepted as standard, 7 ft.-c. The results may then be compared with the norms for these limits which have been established at that intensity.

(2) In testing for incipient pathological conditions, sensitivity can be added to the study by reducing the visibility of the stimuli employed. Decrease of intensity of the illumination of test object and background when the test objects are either coloured or neutral, is one of the three methods of decreasing visibility feasible to employ for this purpose. The other two methods are decrease in the size of coloured or colourless test objects, and decrease in difference in reflection factor between test object and background when the test objects are not coloured. The amount of increase in sensitivity that can be secured in these three ways is limited only by the threshold of visibility. By employing singly or in combination any of these methods of decreasing the visibility of the test objects, faint or incipient scotoma, regional cuts in the visual field, or significant irregularities of outline may be picked up which cannot be detected under the conditions of visibility noted in (1). The early detection of such defects in the field is, of course, extremely important in diagnosis. In the less incipient cases where a defect can be detected by the conditions noted in

(1), the more sensitive procedure is also of value in showing the further spread of the disturbance.[8]

(3) In cases where the pathological condition is well advanced, particularly when only a small segment of the field is sensitive to the test objects ordinarily used, it is desirable to be able to increase the visibility of the test objects in suitably graded steps in order to investigate the regions of the retina where the sensitivity is so reduced that the standard test objects fail to arouse response. In many cases this type of study proves to be very valuable in both diagnosis and prognosis. It is of especial interest in showing the differences in shape of field as outlined by stimuli at different levels of visibility. The conditions for obtaining test objects of higher visibility are, of course, the reverse of those listed above for reducing visibility. That is, high intensities of illumination, large sizes of test object and large differences in reflection factor between test object and background, accomplish this purpose within the limits of increase of visibility by these means.

(4) In all other cases a much more comprehensive picture of the extent and shape of the area of disturbance is obtained by using test objects of lower and higher visibility than would be had by using the standard test objects and conditions alone. This also gives valuable information pertaining to the course the pathological disturbance has taken and is taking.

The most effective way of varying the visibility of test objects for the analysis and study of the visual field is by making the gross changes by increasing or decreasing the size of the test objects or the difference in reflection factor between test object and background, and the finer changes by varying the intensity of illumination of the test objects.

(5) In many types of pathological condition a very valuable contribution to the study may be made by determining the threshold of response to coloured and neutral stimuli in various significant parts of the field, central and peripheral. The sensitivity gradient can be determined, if desired, in any direction in any part of the field or in as many meridians as may be wanted from centre to periphery. With such possibilities there is practically no limit to the thoroughness with which the study of the field or any part of it can be made. With either the variable illuminator and tangent screen combination, or with the Ferree-Rand perimeter equipped with the special illuminating device with intensity control mentioned above, this very important work has now been made not only possible but convenient.

In case of non-pathological eyes the following effects of the visibility of the stimulus on the extent and shape of the fields for form and colour may be noted.

(1) With different visibilities of stimulus the size of the form field may be made to change from full to comparatively small. With change in size there is also change in shape. This is due to the unequal sensitivity gradients in the different meridians.[9]

(2) With sufficiently high visibility of stimulus (high intensity spectrum light, background matched as nearly as possible in brightness to stimulus), the fields for red, blue and yellow may be made co-extensive with the form field. With stimuli of lesser visibility the fields for colour may be made to decrease in size, ranging from large to very small. The decrease in size is attended with still greater changes in shape than for the form field. This is due to the greater differences in the sensitivity gradients for colour than for form from meridian to meridian.[10]

(3) With a suitable selection of ratios of visibility of the stimuli, the comparative sizes of the fields for blue, red, green and yellow may be made to vary from greater to less in any sequence desired. With stimuli of approximately equal energy of the order of visibility that would cause the limits to fall in the mid-periphery of the field, the limits for blue, red, green and yellow interlace. With stimuli of equal energy of a higher order of visibility, the limits for blue, red and yellow interlace; for most observers the limits for green are narrower. This interlacing of limits is due to change in the ratio of sensitivity to the different colours from meridian to meridian. The order of ranking of size of field: blue, red, green, usually obtained with pigment stimuli in medical perimetry, is due to the comparative visibilities of the stimuli employed and does not represent the comparative sensitivity of the retina to these colours.[10]

From the above facts it is obvious that all comparative studies of the extent and shape of the fields for form and colour must be made under controlled conditions of visibility and that for diagnosis critical values for the limits are needed under some set conditions accepted as standard.[11]

Some mechanical means of varying the intensity of illumination is the most satisfactory for the purposes discussed above. In our variable illuminator we have used a shutter the contiguous vanes of which rotate in opposite directions in closing in order to avoid any change in the placement of light, and a diffusing means sufficiently adequate to eliminate all shadows and to give an evenly distributed, well diffused illumination. Under no consideration should a rheostat be used for this purpose because of the radical distortion in colour value produced, particularly at the lower intensities of illumination. With filter means, it is difficult to get adequate durability, neutrality of colour and fineness of steps of change over a sufficiently wide range.

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THE RELATIONSHIP BETWEEN CONJUNCTIVITIS AND TRACHOMA*

BY

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I HAVE been requested to address this General Assembly of the International Association for the Prevention of Blindness and of the International Organization against Trachoma on "The Relationship between Conjunctivitis and Trachoma."

The term conjunctivitis is applied to any form of inflammatory change affecting the conjunctiva, while trachoma is a variety of conjunctivitis, the full name of which is conjunctivitis trachomatosa.

In order to recognise trachoma a definition is required, and I give the following formula:

> *Trachoma is a specific contagious disease of the conjunctiva in man. It is chronic in nature. It is characterized by a subepithelial infiltration of the conjunctiva by a cellular exudate, which spreads to the cornea and to the tarsus. It is followed by cicatricial changes in the affected tissues.*

That the disease is specific and contagious has been proved over and over again by the experimental or accidental inoculation of a healthy human conjunctiva from that of a trachomatous individual. The disease is chronic, such acute manifestations as occur being due, in the majority of cases, to superimposed

* Presidential Address at the session of the League against Trachoma, held in Paris, May 9–15, 1936.

bacterial infections. However, occasionally trachoma gives the impression of beginning acutely; but this is due to the late diagnosis of the disease, which has been present for some time without being recognized; when discomfort is produced by friction of the roughness of the trachomatous conjunctiva on the sensitive cornea, the ophthalmologist is led to evert the upper eyelid and discover the condition. In heavily trachomatized countries the disease is frequently discovered during the course of, or during convalescence from, an attack of acute conjunctivitis. But as the late Charles Nicolle has said, "The acute conjunctivitis is the occasion of the diagnosis and not the occasion of the disease." The majority of the inhabitants of these countries become infected during the first two years of life. Born of trachomatous mothers it can only be by a miracle that infection will be avoided.

A subepithelial infiltration of the conjunctiva is present in every case of active trachoma; the round cells of which the infiltration is composed may be aggregated into clumps or "follicles," but there may be no follicular formation. I have seen thousands of young children in Southern Egypt, where the first stage of trachoma showed a reddened and thickened conjunctiva to the naked eye, but no follicles at all. The infiltration rapidly spreads in the superficial layer of the palpebral conjunctiva to the upper fornix; and from there it travels in the bulbar conjunctiva to the corneal limbus, and it is at this position, at the upper fifth of the corneal circumference, in tissue which is normally clear and avascular, that the first pathognomonic sign of trachoma appears.

The cellular invasion of the normally clear cornea appears first as an indefinite grey infiltration at the limbus. From the convexity of the end capillary loops of the conjunctiva new vessels are developed which run for a short distance towards the centre of the cornea. The cellular infiltration and the new vessels are inserted between the corneal epithelium and Bowman's membrane, and together form the pathognomonic sign of early trachoma, known as pannus.

This phenomenon of infiltration and vascularization of the normally clear corneal periphery in the earliest stage of trachoma requires intense illumination as well as optical magnification for recognition. This is best secured by the use of the slit-lamp. Every doubtful case of trachoma requires examination by this means.

In severe or long-standing cases of trachoma the cellular infiltration between the corneal epithelium and Bowman's membrane partially destroys the latter, when the infiltration penetrates between the layers of the corneal stroma. Marked opacity is thus produced, which becomes permanent on conversion of the inflam-

matory exudate into cicatricial tissue. The folly of an attempt "to cure pannus" therefore is apparent.

The trachomatous changes which occur in the tarsus are first a blocking of the ducts of the Meibomian glands, leading to the bleb-like excrescences of the second stage of the disease, (Tr. II*a*), which emit a gelatinous material when roughly handled; and then to a wide-spread infiltration of the tarsus with inflammatory cells, which becoming resolved into connective tissue, leads to thickening of the structure and entropion.

So that among inflammatory affections of the conjunctiva trachoma is absolutely unique both in its clinical manifestation, pannus, and in the pathological changes which occur as the result of the disease.

In order to appreciate the difference between trachoma and other forms of conjunctivitis the evolution of the former requires consideration. There are four stages, which are divided according to the comparative prominence of subepithelial lymphoid infiltration, bleb-like excrescences, and connective tissue formation.

In the first stage, Tr. I, after an incubation period of from 4 to 10 days a subepithelial infiltration appears, which is usually, but not always, concentrated into tiny greyish islets, the so-called follicles, which, however, are not pathognomic. For diagnosis reliance must be placed on slit-lamp detection of corneal vascularization characteristic of trachoma. In babies and young children it may be quite impossible to use the slit-lamp; in a trachomatous country an infant with a red and velvety conjunctiva may receive the diagnosis of "trachoma dubium," as also must many other cases if no slit-lamp is available.

This stage may be converted into the second stage, or may develop into the third stage directly. On rare occasions both conjunctiva and cornea may return to normal, bearing no trace of the former condition.

The second stage, Tr.II, has been divided into sub-groups for application to different appearances which are common in the East. For present purposes, only one need be mentioned, Tr. II *a*. Here there are the bleb-like excrescences, which are pathognomonic of trachoma. Pannus is invariably present.

In the third stage, Tr. III, the inflammatory exudate is beginning to be replaced by scar-tissue, and there is thickening of the tarsus. Islands of inflamed conjunctiva are seen to be surrounded by a cicatricial network. Here again the condition is typical, and is not imitated by any other form of conjunctivitis. There is always pannus.

In the fourth stage, Tr. IV, all inflammatory changes have come to an end. The conjunctiva is covered by scar-tissue

epithelium and there is more or less cicatricial change in the thin sub-epithelial tissue and in the tarsus. Entropion due to tarsal changes and trichiasis due to proliferation of hair follicles may be present, both of which conditions are pathognomonic.

It is therefore clear that in the first stage of trachoma only, is there any difficulty in making a diagnosis between this disease and other forms of conjunctivitis. This difficulty is resolved by the detection of cellular infiltration and vascularization of the normally clear cornea at the upper fifth of its circumference.

There are no chemical or microscopical tests which, when applied to the conjunctival secretion, assist in making a diagnosis; nor would assistance be obtained by removing a portion of the conjunctiva for microscopical examination. In some cases, but not in all, a light scraping of the conjunctiva removes some of the superficial cells, which, when stained with Giemsa, exhibit the cellular inclusions described by Halberstaedter and Prowaczek; but these are found in conditions other than trachoma, such as in swimming-bath conjunctivitis, and in the non-gonococcal conjunctivitis of infants; nor can they invariably be detected in the first stage of trachoma; it is quite useless to search for them in the second stage.

This essay on "The Relationship between Conjunctivitis and Trachoma" cannot be concluded without an enumeration of the various forms of conjunctivitis which, on occasion, may bear some resemblance to trachoma. They may be divided into common conditions, uncommon conditions, rare conditions, and tropical conditions. They are as follows:—

COMMON CONDITIONS.

Follicular conjunctivitis in children.

Acute conjunctivitis with follicles.

Chronic conjunctivitis with corneal vascularization of former interstitial keratitis, or former phlyctenular ulceration.

UNCOMMON CONDITIONS.

Spring catarrh.

Toxic follicular conjunctivitis.

Parinaud's conjunctivitis.

Swimming-bath conjunctivitis with inclusions.

Conjunctivitis with inclusions not of swimming-bath origin.

Non-gonococcal conjunctivitis with inclusions in infants.

Follicular type of tuberculous conjunctivitis, or syphilitic conjunctivitis.

RARE CONDITIONS.

Actinomycosis.
Sporotrichosis.
Squirrel-plague conjunctivitis.
Bilateral lymphoid infiltration of the conjunctiva.

TROPICAL CONDITIONS.

Trachoma dubium.
Chronic gonococcal conjunctivitis.

It is not necessary to describe the clinical manifestations which characterize each of the conditions of conjunctivitis enumerated above. It is only necessary to say that in the absence of infiltration of the normally clear cornea by a cellular exudate, and of the vascularization characteristic of trachoma, the condition under consideration may be determined to be non-trachomatous.

In conclusion I do not wish to give the impression that I minimize the value of ordinary clinical observation by an experienced trachomatologist in the diagnosis of conjunctival conditions. In many cases of follicular trachoma, stage I, the appearance of the follicles and their position at each extremity of the retrotarsal fold of the upper lid is characteristic. However, no such characteristic appearance obtains in trachoma when there are no obvious follicles, but merely a wide-spread subepithelial infiltration which makes the conjunctiva red and velvety.

INCIDENCE OF MYOPIA IN CHINA

Data and theses from periodical investigations covering thirty years residence, and association with refracting and hospital centres, in a score of the larger cities

BY

O. D. RASMUSSEN

General background.—A sharp distinction had to be made between ancient native refracting methods and treatment and the modern school, represented by comparatively recent medical missionary, private Western, and Western-educated Chinese enterprise.

Modern practices began in the last decades of the 19th Century, spreading rapidly from 1900 onwards. Ancient schools rejected modern ideas within their own craft and in the past ten years

have almost disappeared. Therefore modern methods ran parallel with and independent of the ancient, and aided by Western science and cheap mass production have almost ousted them.

State control, centralised organisation, apart from guilds, scientific data and analyses or any attempt to assemble information through official channels have been absent. Professions have not been registered under State licence, owing to the absence of an accredited standard among so many diverse nationalities in the treaty ports, or in the native schools, or schools run for natives by missionaries and others. Practitioners are responsible only to common and statutory laws of a somewhat inconclusive character in relation to medical practice. The present Nanking government is slowly instituting the necessary legislation.

Ancient Native Refraction:—Here again sharp distinction had to be made between superstitious or legendary beliefs and what little there existed of scientific procedure. As with other branches of Chinese "medical practice," legal restrictions against surgery and post-mortems rendered native knowledge of anatomy and physiology almost entirely empirical. Native opticians managed to keep their craft apart from the herbs, lotions and concoctions of the street-corner physicians, but embellished it with quackery of another sort. They never attempted even the Chinese barber's ritual of swabbing out the eyelids with a swab that did service to all customers until it wore out. When their rock crystal lenses gathered from "pure mountain streams," and mounted in frames made of the tortoise that swam in the same cleansing torrents,

Primitive "fiddle-bow" for drilling holes in crystals.

failed to correct, they washed their hands of the matter. And if the pavement doctors' crushed centipedes, snakeskin and crude zinc oxide also failed they sought the incantations of native monks. For a few coppers they could purchase a bright red elaborately designed scroll with written exhortations to the "Dragon God" (cool water) to drive back the "Red Eyes of the South" (inflammation). This was to be rubbed on the lids, then burned in a saucer and the ashes mixed with cold water for use as an eyewash.

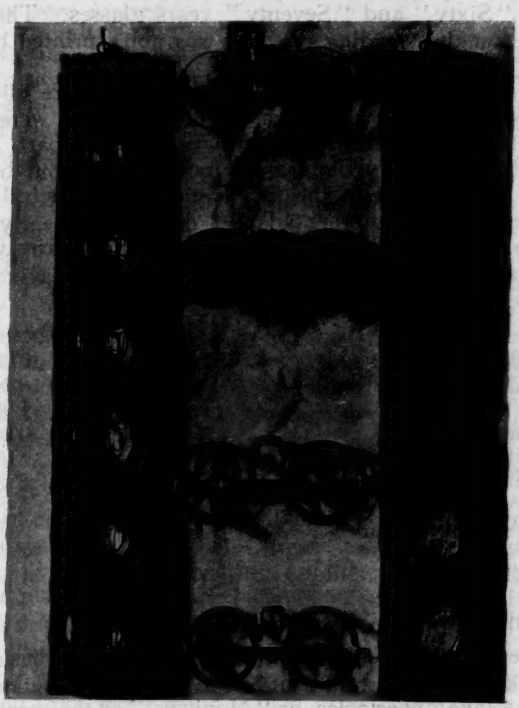
The Chinese "Peng Tsao," or Materia Medica, contains formulae traceable to Greek influences before the Christian era, and the use of lenses in spectacle form can be traced back across Asia to Arabia and Mesopotamia, doubtless, although this is speculative, arising from the influence of Alhazen in the 10th Century through craftsmen imported into China either by conquest or as servants to various Imperial Households at Peking. The form of lens notation, to be mentioned later, lends credit to this supposition, although there is mention of a metal device for sight correction in the Han Dynasty at the beginning of the Christian era.

However, in the Chinese manner, imported ideas eventually became overladen with their own superstitions, or "adapted" by minds unable to comprehend exact science of the crudest sort. The result was to formulate about the organ of sight innumerable legends and fancies, with a thread of just enough common sense running throughout to enable practitioners to do a certain amount of good. They had a God of Sight, a God of the Eyes, and a God of Spectacles. Even the miniature images reflected from the outer surface of the cornea were transposed into "Little Men of the Eyes," guardians of sight and health.

Persistent eye trouble which their refractive lenses failed to remedy was frequently diagnosed as the vicious work of evil spirits, and since in China these demons travel only in a straight line, plane and coloured crystals were prescribed to prevent direct access. This was a round-about manner of alleviating photophobia, and minor afflictions, by providing relief from glare and congestion by virtue of the large mass of cool crystal next to the eyes. There was, unknown to them, a streak of science in their quackery.

These opticians were, however, mainly craftsmen and good in spite of their corollary of mystic mumbo-jumbo. Their knowledge was handed down through father to son under the protective Guild system. Their offices were frontless shops flush with the main street, and their consulting rooms the shop counter, where interested shoppers might watch the consultation, and

Ancient lens grinding tools.



Primitive Test-batteries of the ancient school, with four samples of horn and horn and brass frames.

perhaps, offer a little expert advice. The shop walls were decorated with hundreds of spectacles, ready made in pairs of the same strength, with tabs giving notations, very similar unfortunately to the counter-peddling distinguishing some of our own stores. Nevertheless, behind the simple commercialism ran the thread of adapted science. When nothing in pairs would suit, the optician fell back on a trial-battery of twelve lenses imbedded in two strips of lacquered wood. By covering one of the client's eyes and moving the battery up and down before the other he might find a case of anisometropia, and he might not, much to the client's and spectator's disgust, not to speak of expressed disapprobation. This test was entirely subjective, the "chart" being shop signs up and down the street. If in the case of presbyopes the lower powered lenses in the batteries, which were all concave strengths, were no good, the optician would bring out his four different reading strengths of convex lenses, beginning with his "Lao Kwang" (old sight) correction, which he called the "Forty Years" spectacles. The other three were "Fifty," "Sixty" and "Seventy" years glasses. The test for presbyopes at the reading distance was not a printed book, but the finger print lines.

Notations.—These batteries of minus lenses were all spheres, astigmatism being an unknown quantity. They were surprisingly uniform in cities many hundreds of miles apart, and were graduated, not by any dioptric or focal system, but by animal names as they appear in the first twelve semi-mystical signs of the Chinese zodiac, another adapted device from early Arabian and Mesopotamian contacts. By neutralising batteries used by a score of opticians in different parts of China, they averaged very closely to the following dioptric scale:

Notation.	*Dioptres.*
Tze (Rat)	− 20·00
Chou (Ox)	− 16·00
Ying (Tiger)	− 14·00
Mao (Rabbit)	− 10·00
Shen (Dragon)	− 8·00
Sze (Snake)	− 6·00
Wu (Horse)	− 4·00
Wei (Sheep)	− 3·00
Shen (Monkey)	− 2·00
Yu (Cock)	− 1·50
Hsu (Dog)	− 1·00
Hai (Pig)	− 0·50

Each lens had its name engraved in the lacquer beside it, and habitual spectacle wearers could order new pairs by simply asking for "Snake" spectacles, or "Monkeys," as the case might be.

Plus lenses for presbyopes or occasional hypermetropes were named as stated above, by their client's years, and were almost uniformly plus 1·00, 2·00, 3·00 and 4·00. Plus lenses were rarely given to young men and women even though their error called for a plus correction. Convex crystals were quite definitely labelled "Lao Kwang," or Old Men's lenses, and tradition is hard to break in China. The writer has had a young man refuse such a correction because he could not dare ape his elders or pose as being so erudite as to use their type of spectacle.

Ancient Sight Records.—The ancients did not keep prescription records, but they knew which grinding tools wore out most frequently, and which lenses they could with advantage, keep ready-made for immediate sale. Chinese are better than most people at generalities, and in making estimates of sales they were again amazingly uniform with those in far away regions. From their combined statistics, gathered under severe questioning, and taken from not only current usage but also from the accumulated experience of past generations, the following percentages were derived:

Myopia	(Concave spheres of all values)		65 per cent.
Presbyopia	(Convex lenses only)	...	20 per cent.
Therapeutical	(Plane and coloured)	...	10 per cent.
Hypermetropia	(Clients under forty)	...	3 per cent.
Sunglare	(Plane and coloured)	...	2 per cent.

The incidence of this high percentage of myopia was emphasised by four factors: 1, that test-batteries contained only minus spheres; 2, that very few children or minors were permitted to wear spectacles; 3, that adults were loath to "lose face" by wearing evidence of a personal defect; and 4, that spectacles were relatively expensive and beyond the reach of poorer classes. Against this must be placed the opposite factor that no record was kept of presbyopic myopes obtaining weaker minus corrections for close work. It is possible, judging from percentages under modern conditions, to be given later, that there were large numbers of astigmatics, antimetropes and strabismus cases uncorrectable by the opticians' spheres.

Modern Sight Corrections.—It is necessary, before proceeding here, to lay the canard that Chinese are fond of wearing spectacles for the sake of appearing erudite. The traditional use of crystals, plane and coloured (called Tea crystals, "Ink," and other names according to natural tint) for alleged mystical and therapeutical purposes has carried over into modern usage. Whatever the diagnosis, these crystals reduced the effect of glare, and even plain white optical glass eliminates from 5 to 10

per cent. of light, a sufficient reduction to benefit them, considering their almost uniformly dark irides.

Percentages under the modern school must be approached from a different angle, although the figures are remarkably similar. Under pressure of Westernization, the people's attitude towards spectacles is rapidly changing. Prices are within the range of the poor, prescriptions are more accurate, and practitioners are more numerous and accessible. Mission hospitals with practically free clinics, notably the Peking Union Medical College (Rockefeller Foundation), Chinese ophthalmologists and opticians trained abroad, and private medical and optical enterprise have combined to raise standards and reach the masses with accurate and low-priced spectacles. Much remains to be done, of course, to eliminate mysticism, peddling and quackery, which still thrive in the remoter inland districts.

The following list was compiled from the records of some twenty-five centres of refraction—in institutions mentioned above—in a score of the principal cities, and covers nearly 120,000 cases:

Correction	Maximum Defect	Average Defect	Percentage
Myopia (simple) ...	32·00	3·00	42·
Myopia and Astig. ...	20·00 and 4·00	2·75 and 1·25	16·
Myopic Astig.... ...	4·00	1·00	12·
Presbyopia (convex) ...	4·00	1·75	10·
Hyperopia (simple) ...	5·00	2·00	8·
Hyper. and Astig. ...	6·00 and 3·50	1·75 and 1·00	8·
Hyper. Astig.	5·50	·75	4·

The maximum defect is given merely to indicate some of the known extremes in eyes where corrections gave moderately good vision. Greater errors exist but have been beyond the aid of lenses in most instances. Astigmatism is "with the rule" as in normal European practice. Allowance need not be made for presbyopic myopes, as the averages are based on persons and not transactions. Use by children and young students has greatly increased, but parental antipathy is still strong even in the modernised districts.

The records are not a reliable guide to heterophorias and heterotropias. Practitioners, as a rule, have neither the training nor instruments for accurate diagnosis or treatment of imbalance.

In any case, they have been kept so busy meeting the demand for simple sight correction that muscle findings have been neglected, even where understood. As would be expected of a highly myopic condition, exophorias and exotropias are in the majority, although by no means as high as pure theory would suggest. Records of a few, including the writer's, show that exophoria is present in about 5 per cent., a deficiency of from 2 to 5 prism dioptres at infinity being evidenced under the simple Maddox rod. Esophoria exists in about 4 per cent., and surprisingly high deviations have been found in myopic eyes of equal error and visual acuity. Hyper- and Hypo-phorias follow the normal incidence, usually being present in asymmetrical faces.

Progressive, or malignant, myopia is extremely rare, which may be accounted for by the relatively fewer children coming under observation, although its rarity among those who do is remarkable. The almost general practice of fully correcting myopia, rather than partially correcting it, conflicts with certain Western schools; in fact, success attending full corrections is disturbing to established aetiology. Any tendency for myopia to increase after full correction is offset by just as frequent need to prescribe reductions within the first twelve months. This brings one hard up against the problem of inter-relating factors of length of eye-ball, innervation, diet, orbital and cranial indices, which needs far more space than is available here. The greatest extremes of myopia are found in the middle Yangtze valley where errors of over 20 dioptres are frequent.

Practice under both ancient and modern systems seems to indicate that the onset of presbyopia is earlier than in the West by about 4 or 5 years. The native term, "Forty Years," for a plus one lens need not be considered exact, but its approximation is significant and is borne out, further, by changes taking place in the crystallines of Europeans residing in China for any length of time. Two causes contribute to this change; one, the lower nutritive quality of foods, even of those introduced and grown for European consumption; and two, excessive infra-red radiation from relatively prolonged and intensive sunglare. This is further intensified by reflection from the light yellow loess soil and dust and from the surfaces of rivers and water-courses containing fine loess in suspension, which radiation is not reduced by the tinted sunglasses customarily worn—Crookes', Fieuzal, Smoke, Amber. In the main, presbyopic corrections in the majority of cases, Europeans included, call for plus additions of from half to one dioptre in excess of Donders' and other European scales.

Orbital and Cranial Indices.—The almost superstitious rever-

ence for the dead prevents serious research except of a surreptitious nature. The cranial index for 62 male skulls in North China averaged 78, while the upper facial angle (formed with the Frankfort Horizontal by the nasion-prosthion line) in 58 skulls was 83.5 degrees. The Fronto-orbital deviation angles (which the horizontal axis of the orbital entrance forms with the norma frontalis) were in some 60 male skulls, for the right orbit 13.7 and the left, 14.1 degrees. These indices were compiled with the assistance of the late Dr. J. Davidson Black, known as co-discoverer of the fossil, "Peking Man."

Aetiological Note.—Whatever the predisposing causes of this high incidence of myopia, one fact is certain: that it is widespread amongst all classes of Chinese, and, in view of the prevailing illiteracy (as distinct from folklore and handicraft knowledge) among 98 per cent. of the people, that it must have taken many generations to bring about. Apparently, from the figures available, there is no difference in cranial and orbital indices great enough to account for it by abnormal pressure by the external recti; that is, at the normal close work distance of one-third metre. Academic illiteracy does not dispose of use, and abuse, of accommodation and convergence; at least, not among Chinese peasantry, where families are self-contained economic units doing their own spinning, weaving, clothes-making, building and general domestic handicrafts.

Pupillary distance is slightly wider than in similar mesocephalics of the West, the average male being slightly under 62 mm., and frequently as much as 70 in larger heads. Temple lengths average a quarter of an inch longer than European. Diet, although consisting largely of starchy substances—grains, wheat, millet, rice, with a balance of oils from pork fat, beans and vegetables and proteins from other sources, usually domestic fowl, duck and fish—would not account for undue deficiency in eye structure. The known "sub-normal" accommodative power existing simultaneously would tend partially to neutralise this effect. If diet is a cause, it is not so much its type but its chemical content, and shortage of those elements necessary to eye growth, owing to inferior cultivation and the nature of soil and water, which in the flat coastal and Yangtze valley plains contains high percentages of alkalies and limes in various districts.

The chief cause, in the writer's opinion, is the form of education which has existed for two thousand years, intensified by gross abuse of the accommodative-convergence faculty. The only form of learning was by written and printed characters in books, elaborated and standardized by state examinations for the civil service. Thousands of character-hieroglyphics had to be read,

memorised and later reproduced by candidates locked in cells in the ancient Examination Halls. From the beginning of this monumental sight and memory task, children were permitted to crouch forward over much-thumbed books of coarse yellow paper covered with almost indecipherable smudges. The writer has seen several of these ancient schools, packed closely at primitive desks in a foul atmosphere, with children between the ages of 4 and 16, chins resting on fists, which in turn rested on the low desk, their books a few inches from their eyes. Looking at the

Typical habits of children at studies. The "ancient" teachers made no effort to correct the practice.

class from the teacher's desk, only the tops of their heads were visible, as they droned a monotonous chant to aid their memorization. They are now, happily, almost entirely superseded by modern classrooms.

Schoolrooms, like their houses, were poorly illuminated; two small windows, with less than one square foot to fifty of floor space, being most common. It took the writer, in most instances a few minutes to get accustomed to the poor light after going inside. It is not improbable that the abnormal accommodative-convergence distance and angles forced on the children by these pernicious habits of constant over-innervation would account partly for the low incidence of exo-phorias and -tropias. In young eyes, with plenty of reserve accommodation, the effect on the crystalline would be less than the cramp on the internal recti, thus establishing in due course a false relation between accommodation and convergence.

An important proof of the writer's thesis is the fact that, under modern conditions, where often two and three generations have been schooled by mission or Chinese enterprise, the children requiring lenses reveal a marked diminishing of myopia and a relative increase of hypermetropia.

Diseases.—Briefly, trachoma is most general of the more malignant types, whole villages in North China being afflicted. Corneal ulcers, especially rodent, catarrhal and serpent, have left their scars and trail of blindness on innumerable eyes. Practitioners usually make a point of examining for cicatrices before other routine; hence the almost general use of keratomers. Next in severity are sarcoma, orbital tumours, various forms of retinitis and the almost endemic catarrhal and purulent conjunctivitis. Detachment of the retina is not so common as might be expected and cataract has no more than normal incidence except in mid-Yangtze valley, where conditions approach those in parts of India. Ptosis, keratoconus, and other afflictions occur in more or less normal degree, but glaucoma is extremely rare. The first two causes, trachoma and ulcers, account for most of the 3 million blind in both eyes, and 5 million in one eye, as estimated a few years ago.

THE PRINCIPLES OF ORTHOPTIC TRAINING

BY

SHEILA MAYOU

LONDON

PURPOSE.

It is well known that a patient who squints has monocular vision and it is our aim to give him binocular vision. It is realised that the squinter uses only one eye: what is happening to the vision of the other? It is obviously being suppressed unless there is diplopia present. The squint may be either an alternating strabismus, in which case the visual acuity of each eye would be equal, or it may be unilateral. A patient with a unilateral strabismus may or may not have an amblyopic eye. If there were no amblyopia present, it might be necessary partially to occlude the good eye, until the deviating eye was able to fix at will. If there were amblyopia present, the good eye would be either totally or partially occluded, until the patient was able to alternate.

The first stage is to teach the patient to obtain simultaneous perception, that is to say, to see an object with both eyes at the same time, and in order to do this, unless the visual axes are

parallel, the patient must, at one time during his training, have diplopia. Once a patient has overcome amblyopia and suppression and has not sufficiently good binocular vision to overcome any deviation that may be present, he will have diplopia.

From simultaneous perception we shall pass to fusion, which is the mental power of blending the two images together, and thus convert the diplopia into binocular single vision.

The third and final grade is stereoscopic vision: the ability to judge distances and to appreciate depth.

AGE.

The age of a patient is a very important question to anyone who is contemplating a cure by orthoptic exercises. In many cases the age depends on the type of case. Thus an esophoria of thirty-five to forty years might receive a great deal of benefit from treatment, but in the case of a squint of the same age the exercises would probably overcome the suppression and the patient would be left with diplopia. By surgical means and further training, it would be possible in a young child to overcome the diplopia and obtain binocular vision, but where the squint is of long standing it is very doubtful. The diplopia once having been awakened might not easily be suppressed again. Again, where there is amblyopia of a high degree, it is not usually possible to recover the visual acuity once the patient is in his teens and therefore it would be rather a waste of time to attempt to cure the deviation by exercises. The most suitable age is, I think, between five and six years; should there be amblyopia present it is generally fairly easily overcome by total occlusion of the good eye. The child at this age should be sufficiently intelligent and interested to understand what is required of him. On the other hand I have had some children of two years old who have either attended for treatment or worked at home on small machines. These cases need endless patience and a great deal of help from the parents, otherwise it is better to leave the child until he is between three and four years of age, but the child should be kept constantly under supervision, to see that amblyopia does not develop.

Treatment has proved satisfactory with children up to the age of eighteen years, whether the exercises alone have been sufficient or whether the exercises with the aid of surgery have proved necessary. It is obvious that the younger the case, the greater will be the possibilities of obtaining a cure by exercises only. A number of cases over the age of twenty where there has been a squint of long standing have developed binocular vision, but not always stereoscopic vision, and therefore it is inadvisable in cases of this type to encourage diplopia as it might not prove to be possible to suppress it again.

OPTICAL CORRECTION.

Before attempting to test a patient's binocular vision, it is essential that any refractive error should be corrected, and that the patient should be accustomed to wearing glasses.

The optical correction plays an extremely important part in the treatment of convergent strabismus, and the cases which are most amenable to treatment are those where the angle of deviation is lessened when the proper optical correction is given.

The wearing of an optical correction is not sufficient, for if one eye were amblyopic, the eye would not function, and therefore the correction would be very little use to that eye, until it was made to function as well as the other. Amblyopia must first be overcome by the aid of an occluder and a proper optical correction. When the patient is able to use both his eyes to look at an object, he is then receiving the full benefit of his optical correction.

What is the use of prisms in a case of a squint? A prism is used to bring the retinal image to the deviating eye in the position required for fusion. This could only be effective if the deviating eye had an image perceived by the brain, that is to say, if diplopia was present. In the case of a child, it is very much better to encourage mental effort in overcoming the diplopia, if horizontal, but if vertical, treatment is often assisted by giving a small prism that will overcome half to three-quarters of the vertical imbalance. After the patient has obtained fusion with the correction, the prism may then be reduced and a further effort must be made to get binocular single vision, until the vertical imbalance has been entirely overcome and no prism is necessary.

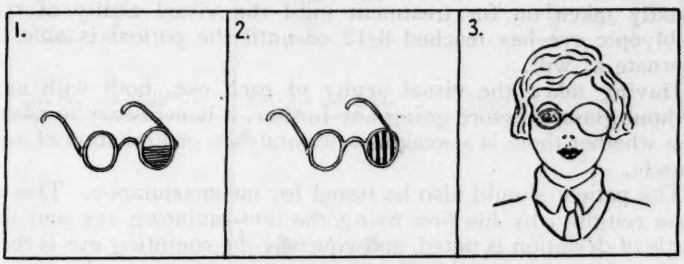
A great number of patients are unable to read, and therefore do not know their letters or numbers, wherefore it becomes impracticable to use Snellen's Test Types for these young children. Vision is tested, however, either by making them tell us what toys they are able to see, or by means of a rotary "E." Several cards, with objects such as balls, dolls, etc., have been graded in a similar way to the Snellen's Test Types, so that it is possible to determine the visual acuity of each eye fairly accurately. The rotary "E," is a much more satisfactory and accurate test. The patient is given a metal " E " which is held in the hands, and in the distance he perceives a series of " E's," the one at the top being fairly large and the bottom ones quite small. They are graded in a similar way to the Snellen's Test Types. If the " E " on the card faces the left, then the patient places his also to look to the left; if the " E" on the card faces downward, the patient must make his also look downward, and so on.

The visual acuity having been determined, it must then be decided whether it is necessary to occlude one eye. This depends on the age and if there is any amblyopia present.

The occlusion may be carried out with a Doyne's disc, but during the past year I have been using adhesive plaster which has been stuck on the lens of the patient's glasses. The plaster is cut so that it overlaps the lens in all directions, and a special projection is made across the bridge of the nose.

The reason for this projection is to stop the child from looking through the corner of the patch. In the case of the disc, the child is apt, unless it is very well cut, to look through the side, but the

DIAGRAM I.



1. Partial occluder, the left eye will be totally occluded for reading only.
2. Partial occluder, the left eye will be partially occluded all the time.
3. Total occluder, the left eye will be totally occluded.

plaster being soft, moulds to the face and does not cause any irritation. (Diagram I, Fig. 3).

Where the visual acuity is 6/12 a partial occluder can be used. This may take the form of strips down the centre of the lens of the good eye. Care should be taken to see that the child is using the amblyopic eye, as some patients prefer to look through the strips rather than use the non-fixing eye, in which case the good eye must be totally occluded. (Diagram I, Fig. 2).

Atropine may also be used as a means of recovering vision. Ointment or drops are placed every morning in the fixing eye. This is to encourage the patient to use the non-fixing eye for near work. Where there is amblyopia of 6/12 or more, the child will continue to use the atropinised eye wherefore it is obvious that the use of atropine is not satisfactory in all cases.

Placing a plane glass over the atropinised good eye is another method of overcoming amblyopia. In many ways this is satisfactory, if the patient will use the amblyopic eye. Occlusion in some cases increases the angle of squint, whereas if the patient is having atropine he will still be able to get binocular vision for distant objects.

Another method of partial occlusion which acts in a similar way to atropine, is to paste a piece of paper on to the lower half of the

lens in front of the fixing eye. For distant vision he will then be using both his eyes, as they will be looking through the upper portion of his glasses. For reading he will use the amblyopic eye only, through the lower half of his lenses. At the same time the lower half of the lens is used for the good eye. In this way distant binocular vision is obtained and the amblyopic eye is being used solely for near work. (Diagram I, Fig. 1).

Vision up to the age of twelve years in most cases will improve from 6/24 to 6/6, but above this age it is doubtful how much improvement can be expected. Cases with amblyopia are not usually taken on for treatment until the visual acuity of the amblyopic eye has reached 6/12 or until the patient is able to alternate at will.

Having taken the visual acuity of each eye, both with and without glasses, before going any further, it is necessary to ascertain whether there is a weakness or paralysis, or limitation of any muscle.

The patient should also be tested for inconcomitancy. This is done roughly, by his first fixing the non-squinting eye and the angle of deviation is noted, subsequently the squinting eye is then fixed and the angle noted. If the convergence increases when fixing the squinting eye, the patient is said to be inconcomitant, and his prospects of a cure are dependent on whether the inconcomitancy is slight or very marked.

The patient is said to be concomitant if the angle of convergence appears to be the same when fixing either eye; also the degree of convergence must not increase when the patient looks to the nine points of the field of vision.

The patient is then tested on the Worth Four Lights test.

These lights test for binocular single vision in the distance, and consist of four lights, one red, two green and one white. The patient is given a red and a green glass, one in front of each eye.

If the patient has a squint he will see:

3 lights if he is suppressing one eye. The colours of the lights will depend on which eye is being suppressed.

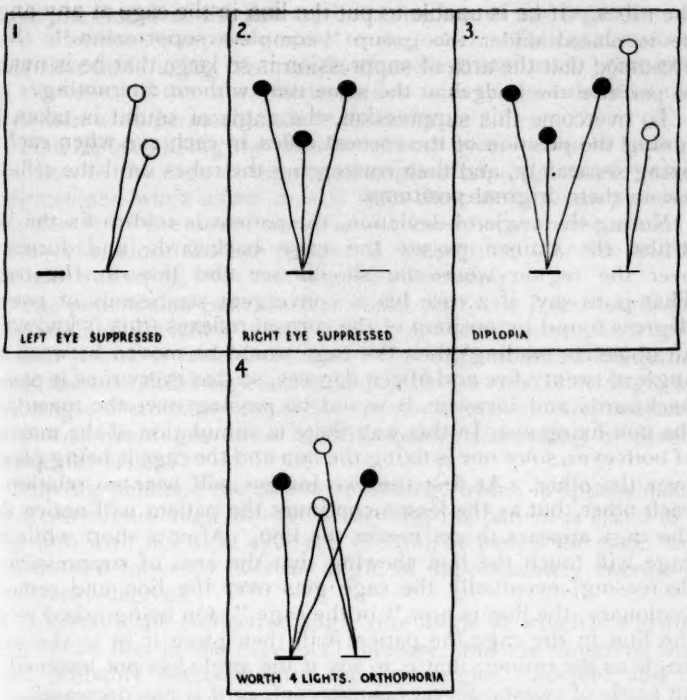
3 or 2 lights if he alternates, first the red and then the green.

5 lights, in which case either the fusion is not sufficiently strong to overcome any small muscular defects, or the angle of deviation is too great to be overcome by fusion, and he may have diplopia.

4 lights, in which case he has binocular single vision.

If the squint is not of large degree, the deviation is usually measured by the Maddox Rod test and Wing test, using the rod

DIAGRAM II.



Worth's 4 Light Test.

first in front of one eye and then in front of the other, in case there should be inconcomitancy.

The testing of binocular vision follows. The first stage, as has already been mentioned, is to obtain simultaneous perception, that is, to make the patient use both eyes together when looking at an object.

Suppression at this stage of treatment may fall into one of the three following groups :

1. Complete suppression.
2. Abnormal correspondence of retinal points or false projection (binocular).
3. Partial suppression.

The patient is seated in front of the synoptophore and given two slides such as a lion and a cage, which have no fusion element

present. He is asked to put the lion in the cage by moving the tubes. If he is unable to put the lion in the cage at any angle he is placed under the group "complete suppression." It is presumed that the area of suppression is so large that he is unable to perceive the images at the same time without alternating.

To overcome this suppression, the angle of squint is taken by noting the position of the corneal reflex in each eye when each is fixing separately, and then converging the tubes until the reflexes are in their original positions.

Noting the angle of deviation, the patient is told to fix the lion whilst the trainer passes the cage backwards and forwards over the region where he should see the lion in the cage. That is to say, if a case has a convergent strabismus of twenty degrees found by position of the corneal reflexes (this is known as an objective reading) then the cage would be moved between the angle of twenty-five and fifteen degrees, so that every time it passed backwards and forwards it would be passing over the macula of the non-fixing eye. In this way there is stimulation of the maculae of both eyes, since one is fixing the lion and the cage is being passed over the other. At first the two images will bear no relation to each other, but as the lesson continues the patient will notice that the cage appears to get nearer the lion. After a short while the cage will touch the lion shewing that the area of suppression is decreasing, eventually the cage gets over the lion and remains stationary, the lion is now "in the cage." On being asked to put the lion in the cage the patient will then place it in at the same angle as the trainer, that is to say if the angle has not lessened, at an angle of twenty degrees convergent, or if it has decreased, at a lower angle. He has then obtained simultaneous perception, since the objective reading (the angle obtained by the trainer by the position of the corneal reflexes) and the angle obtained by the patient, (the subjective reading) coincide. The next stage is to obtain simultaneous macular perception.

2. *Abnormal correspondence of retinal points or false projection.*

A number of patients fall under this group. For example, a child with good visual acuity in both eyes wearing glasses seems to have approximately twenty degrees of convergence which measured on the tangent scale proves to be true. The child is placed in front of the synoptophore, showing him a lion and a cage, he is asked to put the lion in the cage by moving the tubes. When he says that the lion is in the cage the degree of deviation is found to be five degrees of convergence only. On examining the child's eyes to see the position of the corneal reflexes it is noted that in one eye it is fairly central whereas in the other it is

" on the outer margin of the cornea." If the child is asked to look from the centre of the lion to the centre bar of the cage, the eyes will alternate from one picture to the other. This is due to the fact that he is using the macula of one eye and some other point of the retina of the other, he looks first with the macula of one eye and then with the macula of the other eye.

Had he been using the maculae of both eyes, he would have put the lion in the cage at the actual angle of squint, namely twenty degrees and when asked to look from the centre of one picture to the centre of the other, there would have been no movement of either eye, since the two centres of the pictures coincide and the patient was using both maculae simultaneously.

The patient that puts the lion in the cage at a lower angle than the angle of deviation is said to have abnormal correspondence of retinal points or false projection. The angle at which the patient puts the two slides together is known as the subjective angle and the angle obtained by the trainer is the objective. The subjective and objective angles must coincide before attempting to develop binocular vision.

Having obtained the objective reading, which is approximately at a convergent angle of twenty degrees, the patient is asked to fix the lion with his right eye, and the trainer passes the cage backwards and forwards over an angle of approximately twenty-five to twenty degrees.

Gradually the subjective angle (the angle at which the patient places the lion in the cage) will increase, and the objective angle will probably decrease until the two angles coincide, and the patient obtains simultaneous perception. Simultaneous macular perception must now be obtained.

It is interesting to note that the number of cases that have no binocular vision when first tested is fairly big, and this, I think, is one of the reasons why some squint operations have not turned out successfully, even though, after the operation was performed, the eyes stayed straight for a week or so.

Out of nine hundred cases which consisted of esophorias, exophorias, divergent and convergent squints, three hundred had no idea of binocular vision, that is to say one third of the total number.

These three hundred cases can be subdivided into those which had abnormal correspondence of retinal points, and those which had complete suppression when first tested.

Of three hundred cases, one hundred and forty-four had abnormal correspondence of retinal points, and one hundred and fifty-six had complete suppression. That is to say, of the three hundred cases who had no binocular vision, one half had

abnormal correspondence and the other half had complete suppression. This, I think, points out the necessity for pre-operative treatment if a concrete result is the ultimate aim.

3. *Partial suppression.*

All cases who have just overcome suppression and non-correspondence of retinal points come under this heading. Cases which have some binocular vision but have an angle of deviation also fall in this class. The class may be subdivided into two groups which consist of:

a. Simultaneous macular perception.

b. Simultaneous foveal perception.

The cases that have just obtained normal correspondence of retinal points still have a large area of suppression to overcome; on

DIAGRAM III.

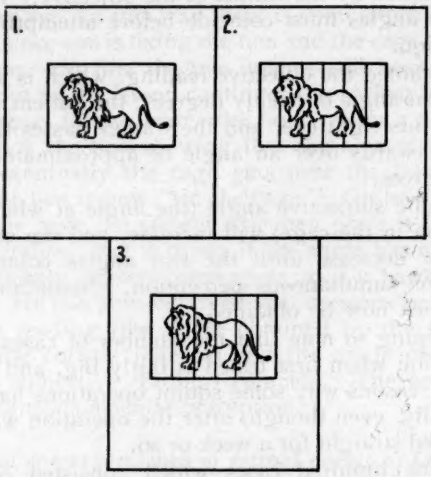


Diagram showing slides as seen by a patient with an area of suppression.

being asked what exactly they see, having put the lion in the cage. they will probably say that they see a lion with a square round him, but there are no bars at all. As the suppression decreases the bars of the cage will be seen at each end and then above and below the lion, but wherever the lion is there will be no bars. As the treatment continues the area of suppression will decrease; the patient will then be able to see all the bars, but the lion will appear to be in front of them, and then after a while he will be able to see

the bars in front of the lion. The lion should then be placed in front of the other eye and the patient worked until he is able to see the bars of the cage in front of the lion, that is to say he has simultaneous macular perception. The slides used to determine this subtend an angle of eight degrees.

When the patient has obtained simultaneous macular perception we then try to obtain simultaneous foveal perception. To obtain this the patient is given a small image to look at, let us say a lion and cage, subtending a visual angle of three degrees, and in order to have simultaneous foveal perception the patient must see the bars of the cage in front of the lion. It is advisable not to attempt to teach a patient to fuse until he has simultaneous macular perception and has attempted to get simultaneous foveal perception. At this stage the patient should be encouraged to get diplopia. This is helped by the myoculator. The myoculator is a machine which improves ocular motility.

The myoculator moves an illuminated object across a wall. The pace at which the image is moved can be regulated, the range can be lengthened or shortened, and the direction can be changed.

The patient is first taught to alternate, by giving him red and green glasses and a septum. As the image travels across the screen, the patient is obliged to use first one eye and then the other. He will then notice that as he changes from one eye to the other, he will see two images simultaneously, one red and one green. The septum may now be removed and the patient should then be encouraged to see two images simultaneously, one red and one green. The red and green glasses should then be removed, and the patient will again suppress and see only one image, but after a while he will overcome this suppression and be able to see two images without the help of the red and green glasses.

FUSION.

Fusion is the mental power to blend into one the impressions received by the two eyes. In fusion exercises the patient is given two similar pictures which differ in some aspect from each other, but when blended together make a third picture which is different from the other two. For instance the following might be used (*a*) a bear with a red coat and black and white striped trousers, and (*b*) a bear with a white coat with black spots, and all blue trousers. When these two slides are fused, the resultant image should be one bear with a red coat and black spots, and blue trousers with black stripes. Where there is suppression, one image will disappear, so that it will not be possible to pass to the next stage, which is fusion with amplitude. (Diagram IV).

DIAGRAM IV.

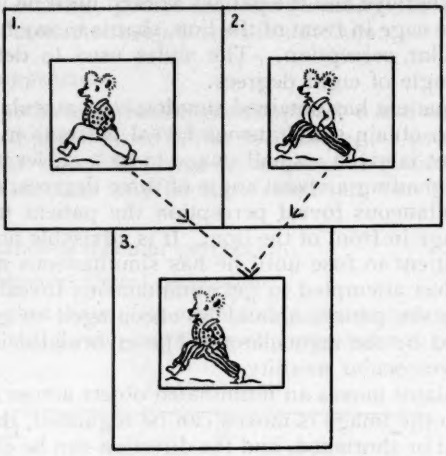


Diagram showing fusion slides.

FUSION AND AMPLITUDE.

This is the ability to maintain fusion while the pictures are abducted or adducted a few degrees. The normal abduction power on the synoptophore is eight to ten degrees and adduction power is forty degrees.

If there is suppression present the trainer may abduct or adduct the patient's eyes, but the patient will not notice when the fusion has broken. It is therefore necessary to be constantly watching the corneal reflexes of each eye to see that the patient is not being allowed to suppress.

The fusion angle is the smallest angle at which two slides can be fused together. That is to say when the slides are fused, and then either adducted or abducted until they part, the angle at which they rejoin is the angle of fusion.

Myoculator exercises.—Since the patient has fusion and some power of amplitude, and diplopia has been elicited, the patient must be taught to bring the two images together, so that they form one image seen by both eyes.

The patient is again given red and green glasses and asked to make a mental effort to get the two images seen on the screen into one. If the image is partly red and partly green, then it is obvious that he has binocular single vision, but should it be all red or all green it can be seen at once that he is suppressing and has only monocular vision instead of binocular.

Stereoscopic vision.—Special slides for training perception of depth and teaching the patient to appreciate solidity have been designed for the training of stereoscopic vision on the synoptophore.

TREATMENT AND MACHINES.

The treatment given to all patients for the main part is done on the synoptophore or synoptiscope, supplemented by the myoculator and various home work machines. It is possible on these machines to work a case with forty-five degrees of convergence, or forty degrees of divergence, and it is also possible to correct for fourteen dioptres of hyperphoria and thirty degrees of cyclophoria. A number of slides have been made for various stages of the treatment, in order to keep the patient's interest. These slides are in three groups and are used for the development of:

1. Simultaneous perception.
2. Fusion.
3. Stereoscopic vision.

The first group consists of two pictures which have nothing in common, there is no fusion element present, slides such as lions and cages, soldiers and boxes, spiders and webs, cars and garages etc., are used.

The second group for the development of fusion consists of two pictures exactly similar in every respect except that on each slide there is a small control mark. For instance, there might be two rabbits exactly similar, except that on one slide one rabbit would have no tail, but a bunch of flowers in his hand, and on the other he would have a tail but no flowers. When these two slides are superimposed the patient would see one rabbit with a tail and a bunch of flowers.

If the patient were suppressing, he would notice that he failed to see either the flowers or the tail, and therefore realise that the pictures were not properly joined. Other slides consisting of Mickey mouse, Pip, Squeak and Wilfred, and many others, are used so that the child may not get bored or tired with his exercises.

For the third stage, the development of stereoscopic vision, special slides have been designed so that the child is able to see whether one object in the picture appears nearer to him than the others. These exercises always prove to be amusing and are usually much appreciated by the patients.

In connection with the exercises on the synoptophore or synoptiscope the patients have home exercises, and these are carried out on small machines which are hired at a low rate from the

opticians. The type of machine given to the patient depends on the stage the patient has reached in his training. For instance, it would be of no use to give a stereoscope with stereoscopic pictures to a child who is unable to fuse.

The home-work machines are graded for each stage in the treatment. For the development of simultaneous perception there is no homework machine. This stage must be achieved by a person who has been trained to give orthoptic exercises, as a parent or nurse could not possibly be expected to measure angle gammas or note positions of corneal reflexes.

After simultaneous perception has been developed, we can give a patient a machine to develop simultaneous macular perception and decrease the area of suppression. This machine may be one of two, either the Maddox Cheiroscope or the Strabismuscope.

On both these machines the patient is given sufficient prism help to correct the angle of deviation, and a special set of toys. These toys consist of butterflies and nets, babies in baths, counters and rings and soldiers in boxes, etc. The parent or the nurse is shown how to use them and instructed to make the child do the exercises at least twenty minutes every day.

For the development of fusion, fusion slides are given on the synoptophore and on the cheiroscope and strabismuscope, a special set of toys with a fusion element is given and worked in a similar way to the first set.

When fusion has been established, amplitude of fusion is developed. To do this, abduction exercises in the case of a convergent strabismus or esophoria, and adduction exercises in the case of a divergent strabismus or exophoria, are given on the synoptophore.

On the cheiroscope and strabismuscope the patient is given fusional drawings to strengthen the fusion. These instruments may now be replaced (if the fusion is sufficiently strong) or supplemented by a stereoscope in the case of a convergent strabismus or esophoria, and amblyoscope in the case of a divergent strabismus or exophoria.

In the case of a convergent strabismus or esophoria, the patient is given a set of fusion pictures and taught how to abduct his eyes by turning the rotary prism in the stereoscope whilst fusion is maintained. Since it is only possible to abduct about ten degrees, an amblyoscope would not be very beneficial in these cases.

Where there is a divergent strabismus or exophoria, the patient is given a set of fusion cards and an amblyoscope and is taught to adduct his eyes whilst fusion is maintained. Adduction after training is normally about forty degrees, and therefore a stereoscope with a rotary prism which will only accommodate twenty degrees will not be of very much use.

For the development of stereoscopic vision, as on the synoptophore, where we have stereoscopic cards, Sattler's stereoscopic cards are used on the stereoscope, on the amblyoscope and strabismuscope a further set of stereoscopic cards are used which have been specially designed. Then, should the case prove to be rather long, there are alternative instruments that can be used at home, such as kinetic stereoscope, which can be used for increasing amplitude of fusion and improving ocular motility: also the diploscope, which has proved to be very useful in the final stages to teach the patient to control his eyes.

Considering now the question of surgical treatment of squint; the question arises as to when operation is indicated. Before orthoptic treatment started in the hospitals, the cases were generally operated on at between 14 and 21 years of age, if by this time they had not grown out of their squint. What was the result of the operation? The eyes were put straight, but since there was no binocular vision, there was nothing to keep them straight, and a great many of these cases returned for a further operation a few years later.

Nowadays, nearly all the non-paralytic squints are sent for training before their operation. Because such a high percentage of the cases that are seen have no idea of binocular vision, it is essential that all cases should, before their operation, have simultaneous macular perception, fusion and some power of amplitude. After operation it is only necessary to develop their stereoscopic vision.

If operation leaves the eyes slightly divergent or convergent, the fact that the patient has fusion gives him the desire for binocular vision, and he attempts to get the diplopia joined, so straightening the eyes. If there were no binocular vision he would suppress one image which would tend to increase the deviation, this might mean a further operation.

In short, orthoptic exercises should be given, whether an operation is necessary or not; exercises should be given before and after operation, in order to consolidate the surgeon's success.

The age at which the operation should be done, entirely depends on the patient. If the child is sufficiently intelligent and can concentrate on the exercises at five years of age, it can be seen whether the exercises alone will prove sufficient, or whether it will be necessary to aid the treatment by an operation, in which case the sooner it is performed the better.

Children who live in very poor districts and attend the hospital clinics often undergo an operation to hasten the cure, although in time orthoptic treatment would probably have effected it. The reason for this is that poor parents cannot possibly spare the time

or money to bring their children to the clinic for treatment over a long period.

Before cases are operated on, degrees of deviation and hyperphoria and cyclophoria are carefully measured on the synoptophore, for the surgeon's guidance.

It is absolutely essential that child and parent should co-operate with the trainer. Occlusion must be carried out properly, otherwise the visual acuity will not improve. Home exercises must be done regularly, as one cannot expect to cure a patient who is only doing two sessions of forty minutes a week. The trainer must be persuasive and make the work interesting and at the same time must instil into the patient the desire for a cure. A patient must be made sufficiently interested to overcome small difficulties, or a satisfactory cure cannot be obtained.

ABSTRACTS

I.—CONJUNCTIVA

(1) **Lyon, M. W. (Indiana).—Conjunctival myiasis. Due to the gadfly, oestrus ovis.** *Amer. Jl. Ophthal.*, June, 1935.

(1) Lyon reports a case of larvae from oestrus ovis deposited in the conjunctival sac. The larvae moved in a caterpillar manner by inserting the chitinous hooks in their anterior extremities into the conjunctival tissues. Their rate of progress was 2—3 mm. per second. Nine were removed by cotton and one passed down the lacrymal duct but gave rise to no further trouble.

The author comments on the fact that the patient was able to localise accurately the precise site in the conjunctiva in which the larvae were active. The larvae are less than 1 mm. long and can be seen with a binocular loupe x 10 magnification. Relief from irritation was obtained by using holocaine and epinephrine ointment.

H. B. STALLARD.

(2) **Tita (Cataniz).—A case of conjunctival infection by larvae of oestrus ovis. (Sul un caso di miasi congiuntivale; oestrus ovis).** *Rass. Ital. d'Ottal.*, September-October, 1935.

(2) In this case the infection was due to a goat which sneezed in the patient's face. This was followed immediately by great discomfort and sensation of a foreign body. A neighbour was able to wash out seven larvae; relief was immediate but the pain returned after a short time.

Tita saw the patient a few hours after. He found two larvae attached to the inflamed conjunctiva. After instilling cocaine, they were easily removed. The larvae proved to be those of oestrus ovis, which is viviparous and attacks chiefly the eyes and nasal passages of sheep and goats. If these seats of election are unobtainable, the fly may attack man. In a case which the author records here, a baby was struck in the eye by a fly and at once complained bitterly; the parents were able to extract a number of small larvae which were not examined and were probably oestris ovis. The child was brought to the author on account of the subsequent conjunctivitis.

HAROLD GRIMSDALE.

(3) **Contino (Messina).—A case of cysticercus of the conjunctiva. (Considerazioni sul cisticerco della congiuntiva).** *Ann. di Ottal.*, November, 1935.

(3) **Contino** gives details of a case whose nature was not recognised until operation was undertaken for its removal.

The difficulty of diagnosis varies with the amount of reaction set up in the surrounding tissues by the parasite. Where this is slight, the nature of the cyst may be recognised through the semi-transparent walls. In most cases there is too much reaction to allow the cyst to be well seen; then its nature will be discovered either at the time of operation, as in the author's case, or after by microscopical examination.

HAROLD GRIMSDALE.

II.—OPERATIONS AND THERAPEUTICS

(1) **Ellett, E. C. (Memphis, Tenn.).—The results of cataract extraction five years and more after operation.** *Trans. Amer. Ophthal. Soc.*, Vol. XXXIII, p. 341, 1935.

(1) **Ellett** reports on the results of cataract extraction in 188 cases from 5 to over 30 years after operation; 114 of these underwent the extra-capsular or capsulotomy operations such as discission and linear extraction, and 74 had the intra-capsular operation. The object of this study was to estimate the number of cases in which useful vision was retained as long as the patient lived. The author has excluded unfortunate results which arose from complications of an immediate or remote nature.

He comments on the alteration in refraction, particularly the astigmatism during the year after cataract extraction and the changes that occur in the posterior capsule rendering capsulotomy

necessary at a remote date from the time of operation. Glaucoma following capsulotomy is described and the author discusses a number of other post-operative complications and gives case notes of some of these at the end of his paper. He states that "the number of patients who failed to retain useful vision once it was regained is surprisingly small." He blames post-operative glaucoma as responsible for a great many disasters. In this paper no statistics are given of the visual results but it is devoted more to a clinical description of the causes of failing sight after cataract operation and a few case notes illustrating these.

The author says that the misgivings as to the effect of the aqueous on the vitreous after the intra-capsular extraction are groundless especially when the hyaloid membrane is unruptured.

H. B. STALLARD.

(2) **Greenwood, A. (Boston) and Grossman, H. (Providence).—An analysis of 1,343 intracapsular cataract extractions by 48 operators following the Verhoeff method.** *Trans. Amer. Ophthal. Soc.*, Vol. XXXIII, p. 353, 1935.

(2) **Greenwood** and **Grossman** describe the technique of intra-capsular extraction as modified by Verhoeff who seizes the capsule with forceps where it is thickest near the equator or adjacent to its upper margin. At this point the capsule is less likely to rupture and if this accident happens there is still some capsule near the anterior pole of the lens which may be grasped and another attempt made to deliver the lens in its capsule. A preliminary iridectomy or a complete iridectomy at the time of operation is necessary unless a special pair of forceps with a blunt heel for insertion under the pupil margin and subsequent retraction upwards is used. Claims are advanced that by this grasp the lens may be pressed against the posterior lip of the wound and vitreous loss thereby prevented.

The authors report the results of this operation on 1,343 cases between January 1st, 1927 and January 1st, 1934, 48 different surgeons including the surgeon in chief, assistant surgeon, clinical assistants and house officers operated on these cases.

The types of cataract were divided into the following groups; immature; mature; hypermature; complicated; uncomplicated and miscellaneous. Rupture of the capsule during delivery occurred in 13·2 per cent. of cases and in 8·6 per cent. the capsules were delivered totally after rupture leaving 4·6 per cent. of ruptured capsules undelivered. In 86·8 per cent. the lens was delivered in the capsule and this plus 8·6 per cent. (*vide supra*) makes 95·4 per cent. in which the lens and its capsule were extracted.

Vitreous loss occurred in 6·2 per cent. A table shows the percentage of ruptured capsules by four groups of operators, surgeons, assistant surgeons, clinical assistants and house officers. It is interesting to note that the least experienced group, the house officers ruptured the capsule in 11.1 per cent., and the most experienced, the surgeons in 11·2 per cent.; next the assistant surgeons 17·1 per cent. and last the clinical assistants 19·7 per cent. The authors comment that in two out of the four services from which these operative results were taken the house officers were allotted the simpler cases and so this may detract from the excellence of the above figures but it is interesting to note that the quality of the performances is directly proportional to the frequency with which the group operates.

Ruptured capsules occurred more frequently in mature, complicated and the miscellaneous groups of cataract and vitreous loss in the hypermature, complicated and miscellaneous types.

The least complications as regards vitreous loss and ruptured capsule were obtained in the immature senile cataracts. These mishaps were highest in the complicated posterior cortical cataracts, ruptured capsule 20 per cent., vitreous loss 25 per cent.

Unfortunately this paper contains no record of visual results obtained after operation and no post-operative or more remote complications are mentioned. The authors state that any operator of ordinary skill and experience need not hesitate to employ Verhoeff's technique.

H. B. STALLARD.

(3) **Rycroft, B. W. (London).—The surgery of corneal grafts with late reports.** *Lancet*, February 1, 1936.

(3) **Rycroft** reviews the history and literature of corneal grafting and comments on a number of technical variations in the conduct of the operation.

His own procedure differs in certain respects from others. The patient receives a general medical examination, septic foci are attended to, attention is paid to sepsis in the conjunctival sac by four hourly irrigations with lotio. hydrarg. oxycyanide 1/8,000 for one week before operation. Local ultra-violet light, the full spectrum from a mercury-vapour lamp is administered for three minutes in addition to irrigations. Medinal 7·5 grains one hour before operation and dilatation of the pupil with atropine form part of the pre-operative preparation.

The author prefers to operate on the patient lying in bed and does not favour transfer to and from the operating table. A circumscribed penetrating graft of 4 mm. diameter is cut from the donor and a bed of similar size is prepared in the recipient's cornea. The edges of the graft are cut straight by the trephine and on

entering the anterior chamber the remainder of the circumference which is undivided is cut through with scissors, no attempt being made to prepare a shelf. The author contends that in fashioning a shelf in the deeper layers of the cornea the area of clear graft is reduced to 2 mm. or so and that also there is a remote risk of this becoming opaque as a result of Descemetitis.

He believes that the use of miotics is unnecessary for the protection of the lens as on opening the anterior chamber the pupil contracts and produces this desired result. Also he states that there is a danger of the iris becoming incarcerated in the wound a few hours after the operation if a miotic has been used as a preliminary.

He uses a total conjunctival flap drawn together with a purse string suture over the graft and the knot placed eccentric to the centre of the graft.

The author records post-operative complications and notes that three types of opacification of the graft may occur. (1) During the first week due to imbibition of aqueous humour into the substantia propria, rapidly clearing towards the end of this week; (2) vascularity from spread of superficial vessels towards the end of the second week, this takes longer to clear but is not permanent; (3) opacification at the end of the first fortnight due to failure of nutrition in the graft. This becomes permanent.

He records the notes of three cases, in two of which the vision was 6/60 and 6/36 six months and one year respectively after operation. The third case suffered an iris prolapse after a graft 6 mm. in diameter had been used and the graft subsequently became opaque with visual improvement from perception of light before operation to counting fingers nine months afterwards.

H. B. STALLARD.

(4) **Kyrieleis, W. (Hamburg).—The Schieck procedure of autoserum injection into the anterior chamber in tuberculous iridocyclitis. (Zur Technik und Wirkungsweise der Eigenbluteinspritzung in der Vorderkammer bei tuberkulöser Iridocyclitis nach Schieck).** *Zeitschr. f. Augenheilk.*, Vol. LXXXV, p. 16, 1935.

(4) Satisfactory results from autogenous haemotherapy are reported by **Kyrieleis** in cases of chronic tuberculous iridocyclitis with keratic percipitates. The author describes a canula of his own, with which he fills the anterior chamber three-quarters full. Rise in tension is uncommon and can be controlled by heat. Only in one case was it necessary to withdraw the injected blood. Acute cases and those with fresh acute exudate are not suitable for this

method of treatment. Old standing keratic precipitates are most influenced and vision is improved.

ARNOLD SORSBY.

(5) **Löffler, A. (Vienna).—Results of the Hamburg treatment of tabetic optic atrophy. (Ergebnisse der Hamburgschen Behandlung bei tabischer Sehnervenatrophie).** *Zeitschr. f. Augenheilk.*, Vol. LXXXV, p. 196, 1935.

(5) **Löffler** reports on 16 cases of tabetic optic atrophy treated by injections of potassium permanganate (the Hamburg treatment). In one particular case 140 injections were given. Whilst no case showed untoward local or general effects, subjective improvement was noted in some. Seven cases did not show any further deterioration in vision; in four deterioration occurred after a period of quiescence; four cases were relentlessly progressive. When vision was poor, the effect was not good—this also applied to the eye with poorer vision in such cases as did relatively well. This method of treatment is recommended in such cases as are only slowly progressive.

ARNOLD SORSBY.

III.—MISCELLANEOUS

(1) **Sanford, H. S., Craig, W. McK. and Wagener, H. P.—An unusual chiasmal lesion and its operative treatment.** *Proc. of the Mayo Clinic, Rochester*, Vol. X, No. 46, 1935.

(1) **Sanford, Craig, and Wagener** report a case of failing vision due to abnormal enlargement of the ophthalmic arteries, vision being materially improved by surgical removal of the roof of the optic canal.

The patient was a female aged 54 years who since the onset of menses at the age of 11 years had noticed "a peculiar sensation of the eyes" for a day or two preceding every period but these disturbances were transient and resulted in no definite impairment of vision.

In June 1935 her vision became temporarily blurred for a few days and on August 4 she experienced a similar attack and noticed her visual field was decreasing. On August 11 her left eye was nearly blind. The form fields were constricted, more markedly in the left eye, with a left absolute central scotoma and right relative central scotoma. Inferior altitudinal anopsia became pronounced on subsequent field examinations. Sclerosed retinal vessels were noted. The blood pressure was 190/110 mm. Hg.

A chiasmal lesion was diagnosed and at operation (left transfrontal craniotomy) the pituitary and adjacent structures were

found to be normal but the ophthalmic arteries were large and tortuous as they accompanied the optic nerve through the optic foramina. It was thought that pulsation of these vessels compressed the optic nerve against the roof of the canal on each side and so a decompression operation was performed removing the roof of the optic canal on each side. The day after operation the patient was blind but after three days vision began to return and eventually recovered to, right vision 6/12, left vision 2/160, right visual field "practically normal," left field was normal in shape, somewhat constricted, and the central scotoma persisted.

H. B. STALLARD.

BOOK NOTICES

Detachment of the Retina. By J. COLE MARSHALL, M.D., F.R.C.S. Illustrations 44, pp. 77. Oxford University Press. 1936. Price 10/6.

This book reviews recent advances made in the operative technique and surgical treatment of simple detachment of the retina. The author describes in detail Gonin's thermo-puncture operation, Guist's chemical cauterization, Lindner's undermining technique, the diathermy or electrocoagulation operations devised by Larsson, Weve and Safar and finally katholysis.

He emphasises the importance of taking a careful history and making a thorough investigation of a case of retinal detachment before an operation is planned.

The author's particular experience has been with the micro-puncture diathermy method used by Safar but a full description of other operative techniques is given.

There are many illustrations of instruments, apparatus, diagrams, charts and fundus drawings of retinal detachment and the results of operations. A short bibliography of the more important original papers concerning this subject and an index are given.

The reviewer feels that the book would have been enriched by a discussion of the aetiology and pathology of retinal detachment especially in regard to the selection of the type of operation for any particular case and of the prognosis. However, there are many difficulties to be encountered in assessing the respective values of these surgical procedures at the present time and it is probably on this account that the author has avoided making any dogmatic statements about a subject that requires a fuller and more thorough collection of case reports before any definite conclusions can be arrived at.

The legend below Fig. 10 states that the current used at Moorfields Eye Hospital is 30 milliampères whereas it is in fact 65 to 70 milliampères.

The printing and production are good.

Forty Years of Scientific Work of Dr. M. I. Auerbach. Moscow. 1935. (Russian.)

The volume of papers compiled by more than 52 ophthalmologists as a commemoration of the 40 years of scientific work of Dr. M. I. Auerbach, a well-known contemporary Soviet Russian authority, is an important and imposing piece of scientific work that would bring credit to any country of Western Europe. It is impossible in a short review to give even a general account of these papers, ranging from phlyctenular affections and their connection with tuberculosis to neoplasms of the orbit and covering practically all the important progress and achievements of modern ophthalmology. If by the quality and method of the published papers one can judge the esteem in which Dr. Auerbach is held by his Russian fellow ophthalmologists, then it must be very high indeed. To point out only a few instances:—the operation of Toti is very popular there and the old operation of complete excision of the lacrymal sac is nearly abandoned. Special stress is laid upon research work in connection with industrial fitness, professional disease and aviation. The operation of the late Cracow Professor Wickerkiewitz—division of all external muscles of a badly injured eyeball—hardly known in Western Europe, is still used with good results in Soviet Russia. Many papers are devoted to tuberculosis of the eyes. One of them is by Professor Meller of Vienna, one of the many foreign contributors to this volume—French, German, Spanish, Austrian, Latvian, Luthuanian, and even two German professors—in spite of the fact that Dr. Auerbach is a Soviet citizen and even—a Jew. It is, therefore, with special pleasure that the reviewer points out this evidence of international scientific solidarity in this period of "nationalism madness"; and here some criticism is legitimate. The Russian workers would only gain in an outsider's eye if they would quote more from Russian pre-Soviet ophthalmological literature than they do at present. After all, it was not so poor.

OBITUARY

J. A. WILSON, O.B.E., M.D.

We much regret the death of Dr. James A. Wilson, of Cambuslang, on February 19, 1936. In our early days Dr. Wilson contributed an article on "Gunshot injuries of cortical visual areas,"

in which he described cases which had come under his observation when resident surgeon to the Lord Derby War Hospital, Warrington. He also wrote on Cinematograph eye irritation; and collaborated with Dr. John Rowan in a paper on Hereditary cataract.

In later years he wrote on Twins with eye defects and on Ametropia and sex, the latter paper being published last year.

Dr. Wilson was trained in Glasgow where he graduated M.B., C.M., in 1880. He proceeded to the M.D. in 1889, and became D.P.H.(Cambs.) in 1890. He was a clinical assistant at Moorfields and also put in post-graduate work at the West London Hospital and Central London Hospital for Diseases of the Throat. At Glasgow he had served as house surgeon to the Royal Infirmary and he was for some years assistant surgeon to the ophthalmic department of this institution. He was the author of several papers in the *Lancet*, *British Medical Journal* and *Glasgow Medical Journal* as well as those in our columns to which reference has already been made.

Dr. Wilson leaves a widow to whom we would wish to offer our respectful sympathy in her bereavement.

NOTES

Corrigendum

IN the account of the Annual Congress of the Ophthalmological Society of the United Kingdom we gave the names of those firms of opticians, instrument-makers and others who exhibited in the Trade exhibition. We regret that the names of the following firms were omitted: Clement Clarke, Ltd., Down Bros., Ltd., and John Weiss & Son, Ltd.

FUTURE ARRANGEMENTS

1936

June 12.—Royal Society of Medicine, Section of Ophthalmology (Annual Meeting).

October 6.—Midland Ophthalmological Society, at Birmingham Eye Hospital.

December 1.—Midland Ophthalmological Society, at Birmingham Eye Hospital.

CONTEMPORARY OPHTHALMIC LITERATURE

Archives d'Ophtalmologie. *April, 1936.*

TOULANT and MORARD. Three new cases of haematic disciform infiltration of the cornea.
ROLLET. The pre-corneal bed of liquid.
VERRIER. Biological study of the retinae of vertebrates.
BAJENOVA. Cultures of preserved corneal tissues.

Annales d'Oculistique. *April, 1936.*

WESKAMP and ALVAREZ. Genuine exophthalmos of Basedow's origin.
CHARLIN. The pathogenesis of albuminuric retinitis.
SAINT-MARTIN. Several operative techniques.

Revue d'Oto-Neuro-Ophtalmologie. *March, 1936.*

TOURNAY. Remarks on the pupillary inequality of the syndrome of sympathetic excitation.
ROGER, JAYLE and PAILLAS. Parinaud's syndrome from hypertony of the depressors and spasm of the elevators with left hemiplegia.

April, 1936.

ROGER, ROCHE, CARREGA and PAILLAS. Unilateral, paralytic global syndrome of the 12th cranial nerves.
SEDAN. Optic neuritis of dental origin.
CARLOTTI, JACQUET and ROLAND. The effects of short waves of very high frequency on the superficial circulation of the ocular globe, the retina and the optic nerves.

Bollettino d'Oculistica. *March, 1936.*

GIANNONI. Recurrent vitreous haemorrhages and haemorrhagic diathesis.
SALA and BORSELLINO. The behaviour of the eye in chronic copper poisoning.
NASTRI. Kahn's reaction in the ophthalmological field.
PETRAGNANI. Contribution to the aetio-pathogenesis of recurrent vitreous haemorrhages.
BASILE. Some effects of Röntgen therapy in haemorrhagic glaucoma.

Archivio di Ottalmologia. *April, 1936.*

BOSSALINO. Edmund Jensen's retino-choroiditis.
BARATTA. Research into the oxalic acid content of the aqueous.
FILATOFF and SCHMOULIAN. The most recent contributions to the question of corneal transplanting from a cadaver.

Klinische Monatsblätter für Augenheilkunde. *April, 1936.*

GROENOUW. Inherited colour blindness. Genealogical tree of five generations.
WÖLFFLIN. Artificial illumination of test type.
VELHAGEN. Practical recognisable colours for colour blind people for air traffic signals.
KIEWE and REH. Macular holes.

VOS. Embryonic synechiae formation between the secondary optic vesicle of Balfour and the lens.
VILA-CORO. The anatomy of Zinn's ring.
UYEMURA and SUGANUMA. A new ophthalmodynamometer.
SPANYOL. Removal of a fly larva from the anterior chamber of an 11 year old boy.
DENIG. The removal of the lens matter which remains behind after operation for immature senile cataract.
HAGEDOORN. Guttate cornea. "Dystrophia corneae endothelialis."
BUSCHKE. Adapted mirrors to facilitate the hollow ball perimetry.

Archivos de Oftalmologia Hispano-Americanos. *April, 1936.*

RENEDO. War gas in ophthalmology.
BASTERRA. Extra-nasal dacryocystorhinostomy.

Archivos de Oftalmologia de Buenos Aires. *March, 1936.*

DAMEL. Anatomy of the central retinal artery and vein in their orbital and neural portion.
ANDROGUÉ and MALBRÁN. Exudative retinitis and retinal cysts.
BALADO. Physio-pathology of the pupillary movements.
LAGLEYZE. Corneal tattooing.

Revista Oto-Neuro-Oftalmologia. *March, 1936.*

PAVIA. Fuchs' spot in high myopia. Some observations.

Revista Oto-Neuro-Oftalmologica y de Cirugia Neurologica Sud-Americana. *April, 1936.*

ALAJOUANINE and THUREL. Sympathetic therapy.
PAVIA. A new oculo-palpebral syndrome. Chronic kerato-conjunctivitis pseudo-membranous or ligneous kerato-conjunctivitis.

Revista Cubana de Oto-Neuro-Oftalmiatria. *September-October-November-December, 1935.*

MENEZO. Action of war gases on the eye.
AMAT. Mercurochrome in ophthalmia neonatorum.
CASTRESANA. Congenital anomalies of the sclerotic.
YANES. Tho use of gloves in ocular surgery.